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RAYMOND CONCRETE PILES

A FORM
FOR EVERY
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A PILE
FOR EVERY
PURPOSE

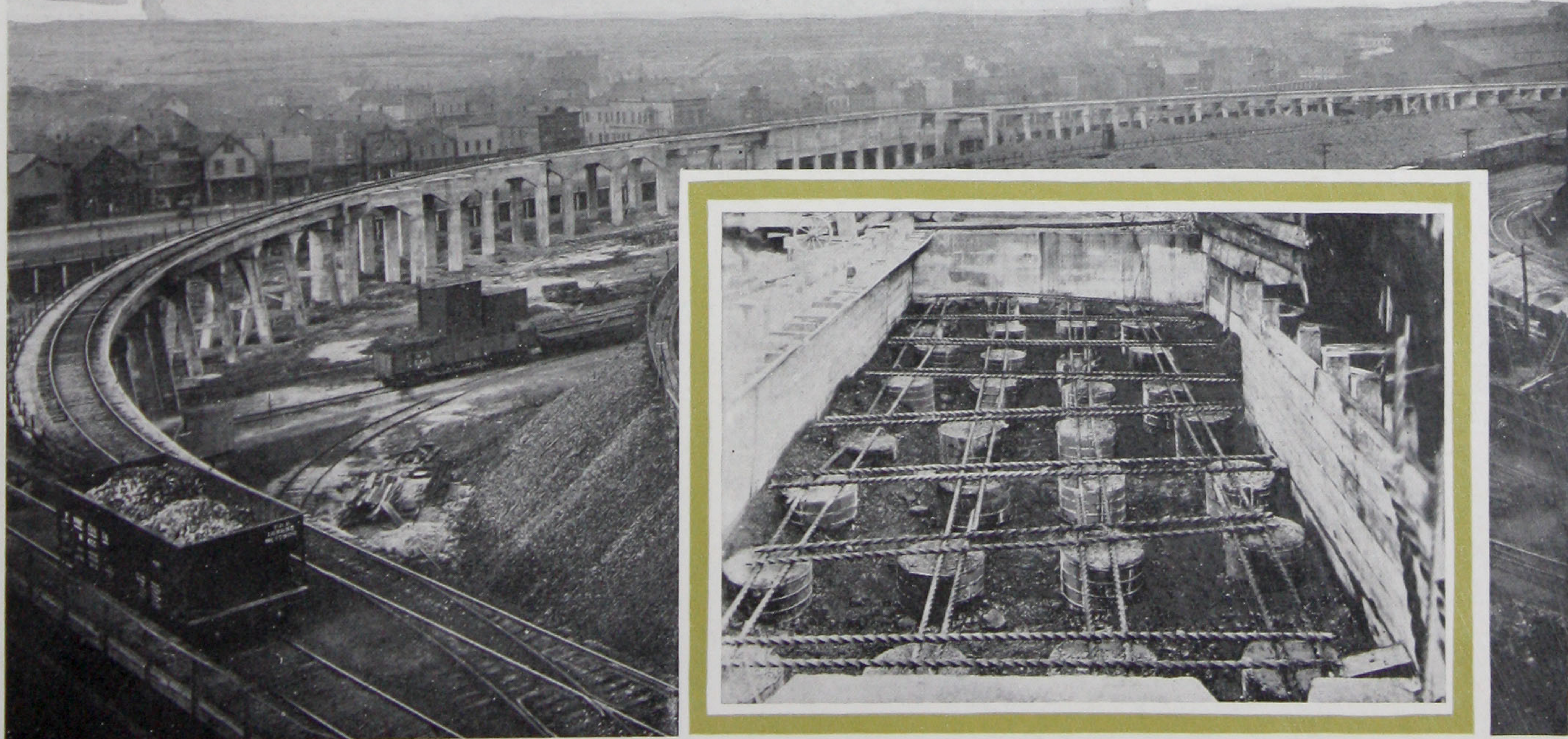


RAYMOND

CONCRETE PILES

AND
SPECIAL
CONCRETE
WORK

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A FORM FOR EVERY PILE

- -

A PILE FOR EVERY PURPOSE



ABOVE—Pre-cast concrete piles driven for a pier at Charleston, S. C., ready for the girders, beams and slab forming the deck. Note the projecting re-inforcing bars, which will be incorporated in the deck construction. Note, also, the wood cushion blocks which will be removed before girders are placed.

BELOW—A group of piles in the foundation of the Steel Building at the Ford Rouge Plant, Detroit, Mich. The piles appear in the photograph to be Standard Raymond Piles, but are, as a matter of fact, composite piles, that portion of each pile which is visible being superimposed upon and firmly anchored to a wood pile of from 70 to 85 feet in length penetrating to hard pan at from 80 to 100 feet below ground surface.



RAYMOND

CONCRETE

PILES

and



SPECIAL CONCRETE WORK

RAYMOND CONCRETE PILE

NEW YORK
140 CEDAR ST.

COMPANY

CHICAGO
111 W. MONROE ST.

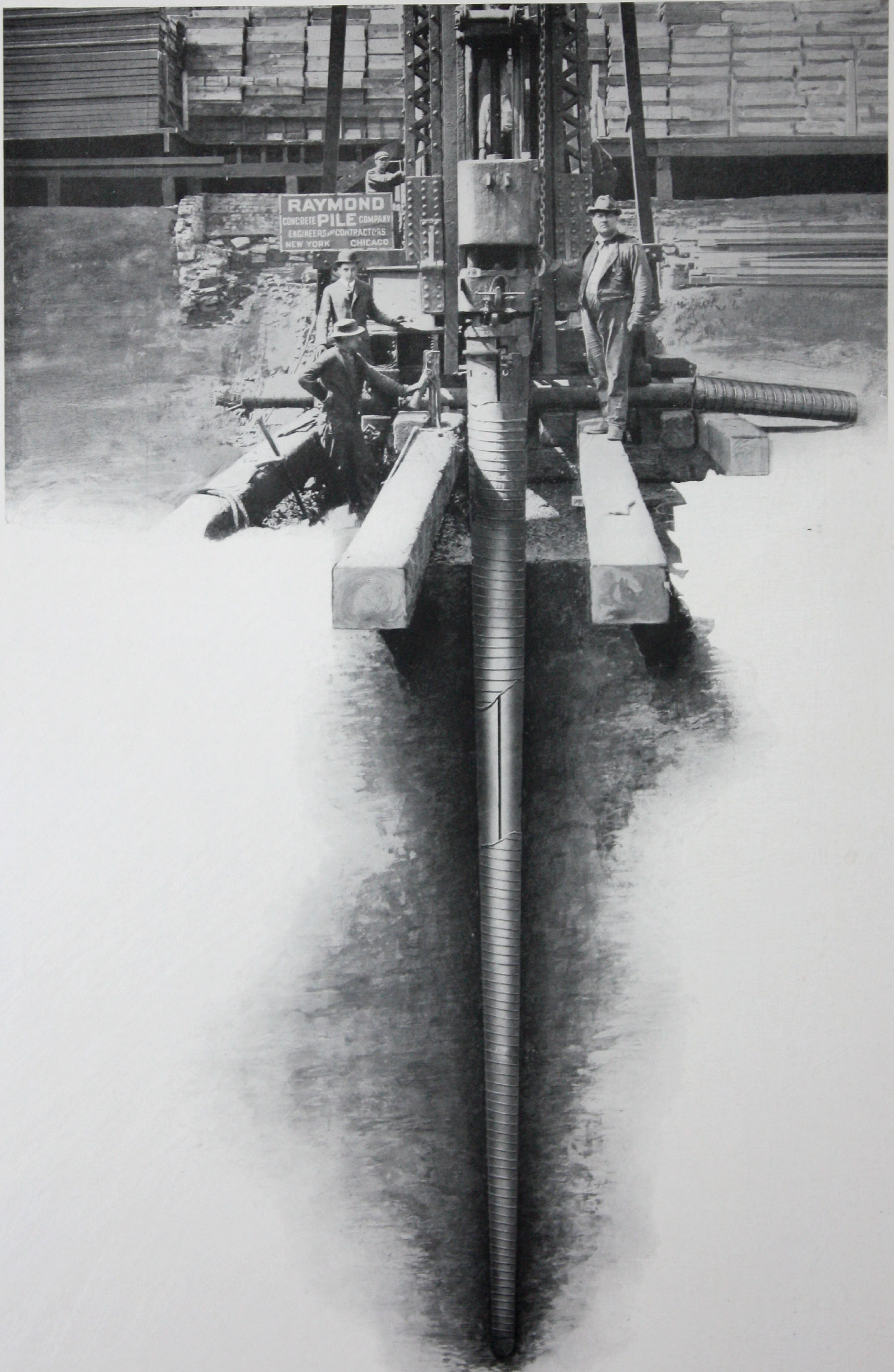
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RAYMOND ■ CONCRETE ■ PILES

THE splendid architectural monuments of the past lie upon the surface of the earth like boulders in a field, while the modern structure of the same relative character rests upon foundations thrust far beneath the surface and stands, sturdy as a mountain, defying the uncertainties of unequal bearing soils.

As the great structures of to-day differ in character and in purpose from those of the ancients, so do their foundations differ. In comparatively few localities can a bed of solid rock be found within practical limits of depth for foundation purposes, yet absolute *natural stability* or definitely calculable bearing values *artificially produced* are essentials in modern building construction. To rely upon the driving of wooden piles for the permanent attainment of these results is becoming less and less the modern engineering practice, owing to several elements of doubt and uncertainty which are inherent in the material, wood, as well as other features which will be discussed later in more detail.

For the moment, suffice it to say that with the driving of the first Raymond Concrete Pile, the greater part of the uncertainty attending the use of pile foundations was eliminated. Since that time improvements of method and materials, carefully worked out on the basis of experience and research, have reduced to a negligible quantity any remaining element of doubt.

In the following pages, arguments, facts and illustrations will be presented, which should be convincing to the prospective builder, technical or otherwise.





Office Building, Jefferson Standard Life Insurance Co., Greensboro, North Carolina.
W. L. Stoddard, Architect.

The Scope of Our Business

ONE of the most reliable of our encyclopaedias, published about the time our business was established, carried this statement under the head of "Foundation:"

"Piles are either of Timber or of Iron"

When the first Raymond Concrete Pile was driven, that statement went out of date. Since that time, Raymond Concrete Piles have made practicable the construction of a large number of buildings under conditions where foundation problems involved were too serious to admit of other economical solution. As a natural result, our business has so expanded as to necessitate the establishment of branch offices in various cities in the United States, and examples of our work are to be found in both of the American continents — from Canada to Chile — Several thousand Raymond Piles have also been driven in Japan and China.

We have on our staff, and at your service, experts in the design and installation of concrete piling for all purposes and to meet all conditions. In addition to our standard Raymond Piles, which are described in the following pages, we design, manufacture and place pre-moulded reinforced concrete bearing piles; concrete sheet piles, both plain and interlocking, also composite piles.

Some illustrations of our work in the design and construction of reinforced concrete docks, bulkheads, sea walls, retaining walls and other concrete structures for which special designs are necessary, will be found herein.

Our Engineering Department is available to architects and engineers at all times for investigation work and will gladly submit recommendations, designs and estimates.



Dormitory Building, Saint Mary's of the Woods, Terre Haute, Ind.
D. A. Bohlen & Son, Architects.



Figure 1

The illustrations on this and the following two pages will serve to convey an idea of the manner in which Raymond Piles are installed.

Figure 1 shows one of our heavy structural steel pile drivers, in the leaders of which below the hammer, is suspended a collapsible steel mandrel, or "pile core." The steel "I" beams upon which the driver is mounted rest upon a steel bed sill with a roller-bearing center, which permits the driving apparatus to swing in a complete circle.

A nearer view of the pile core is shown in Figure 2. The core is in reality a collapsible steel pile, so constructed as to withstand the shock of constantly repeated blows of a heavy steam hammer.

Figure 3 shows the several sections of the spirally reinforced steel shell and the steel boot or cap which closes the bottom. The shell, because it may be driven into the ground with perfect accuracy; because it permits complete inspection after the driving operation is completed and because it provides absolute protection for the concrete, is the most important feature of the Raymond System.



Figure 2

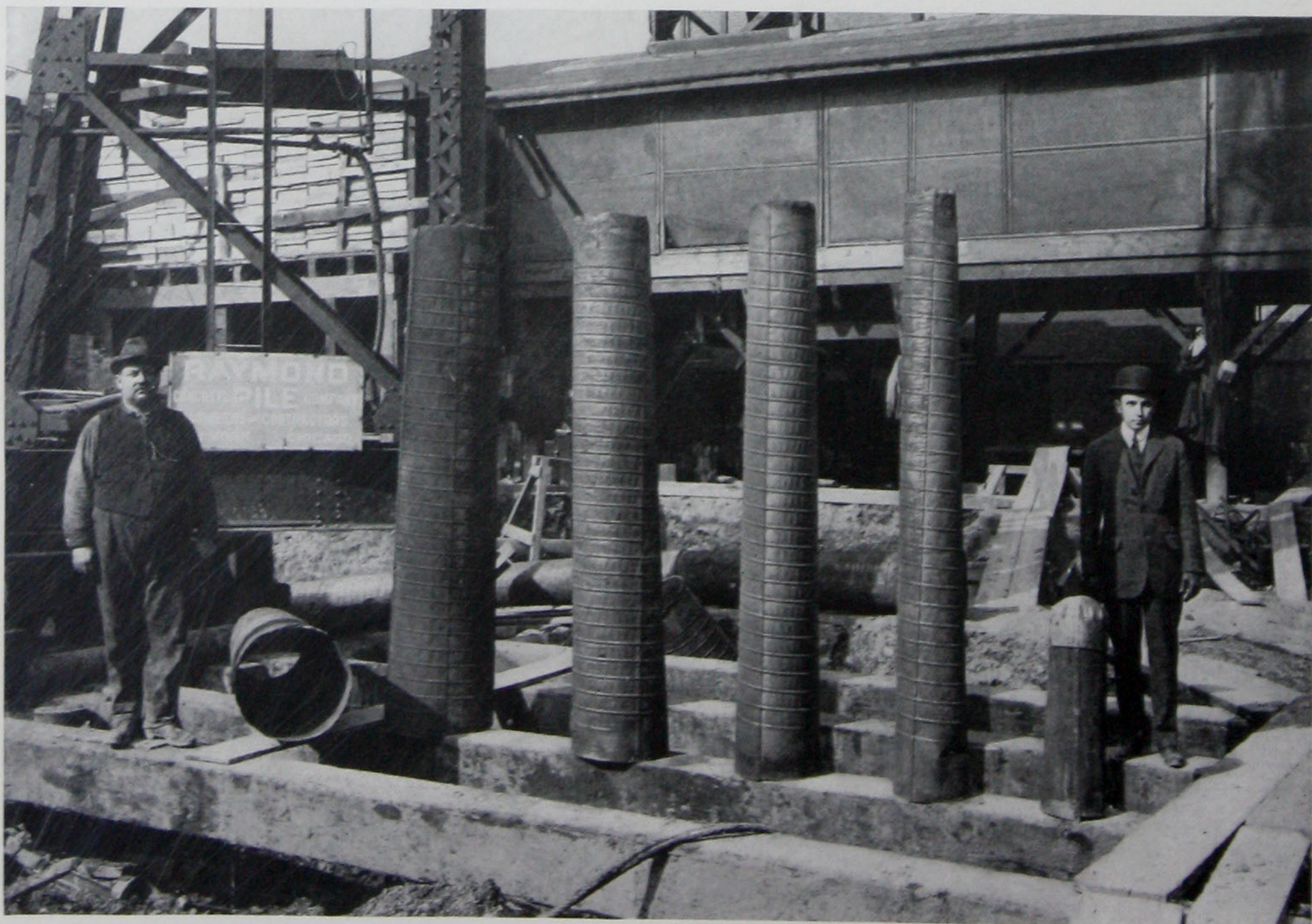


Figure 3

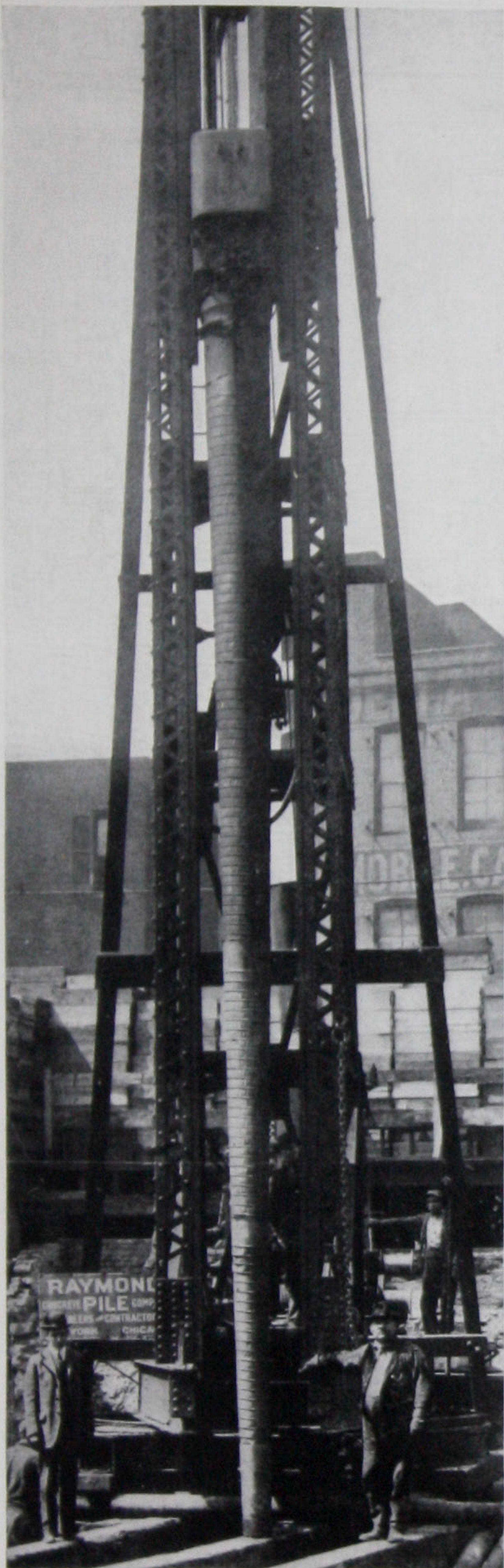


Figure 4

Figure 4 shows the entire apparatus ready to begin work. The shell has been drawn over the core in telescoping sections and closed at the point by the steel boot.

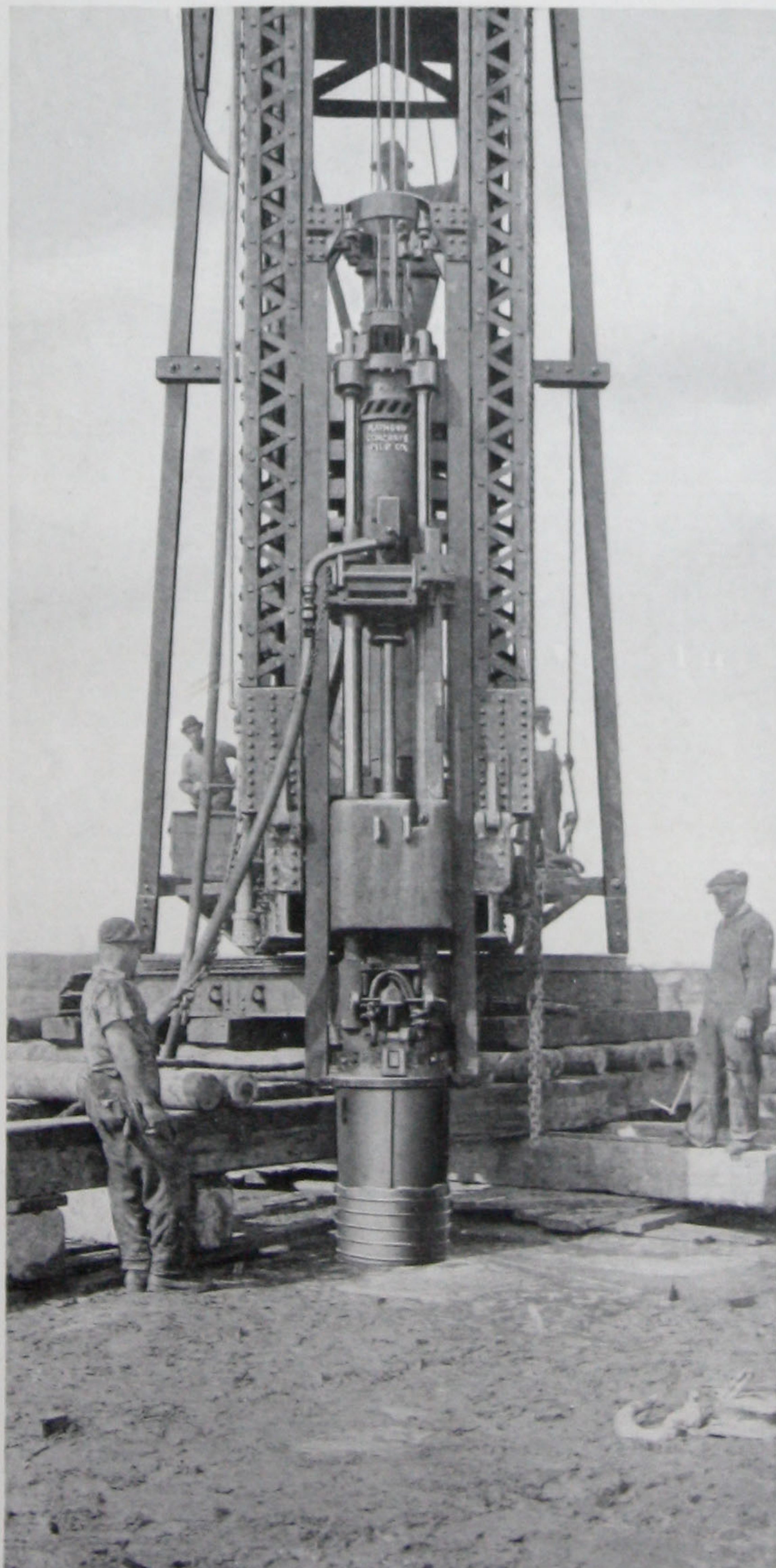


Figure 5

After the driving apparatus is in position, as shown in Figure 4, the shell-encased core is driven to the resistance necessary to provide for the safe working load. The driving is usually done with a steam hammer, as it has been found that from the standpoint of economy, rapidity of installation and safety of adjacent property more satisfactory results can be thus obtained than with a drop hammer.

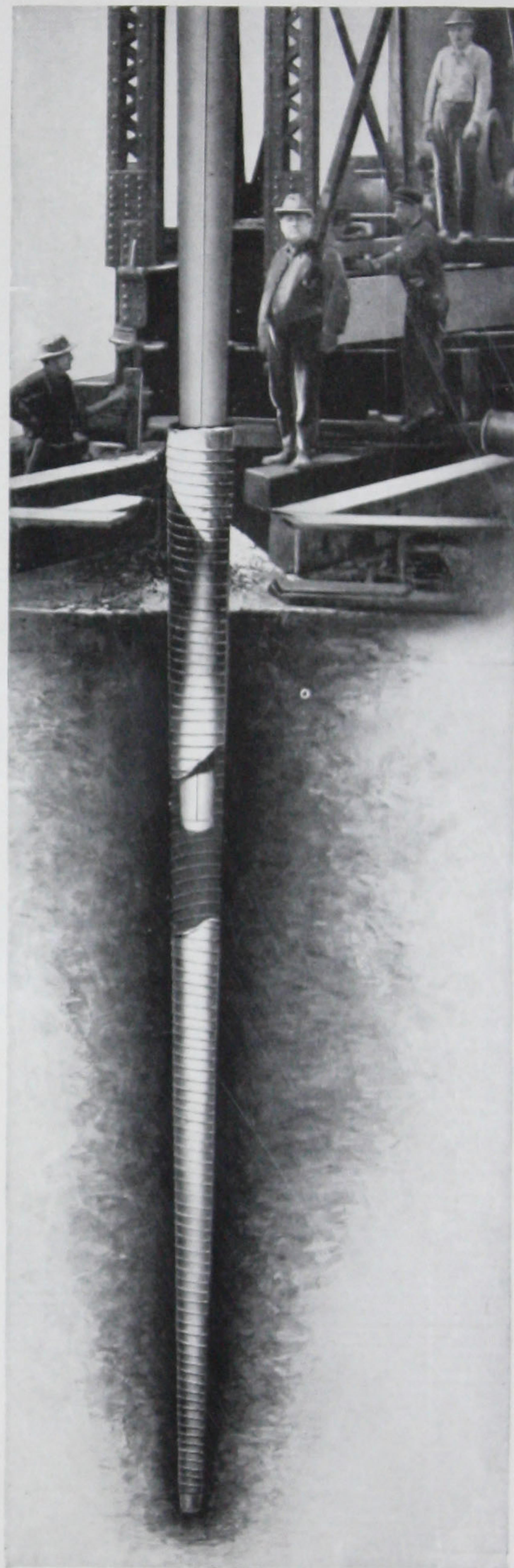


Figure 6

In Figure 6, the core has reached the desired point of resistance and is thereupon collapsed and withdrawn, leaving the shell in the exact position to which it has been driven. The shell is then ready for inspection. (See Fig. 7.)



Figure 7

The shell forms a steel lined hole (here shown) susceptible of careful inspection prior to the placing of the concrete. This inspection may be accomplished by lowering a light to the point of the pile if sunlight is not available. Figure Seven is a view of the unfilled shell, looking from the ground surface to the point.



Figure 9

Group of completed piles ready for the footings.

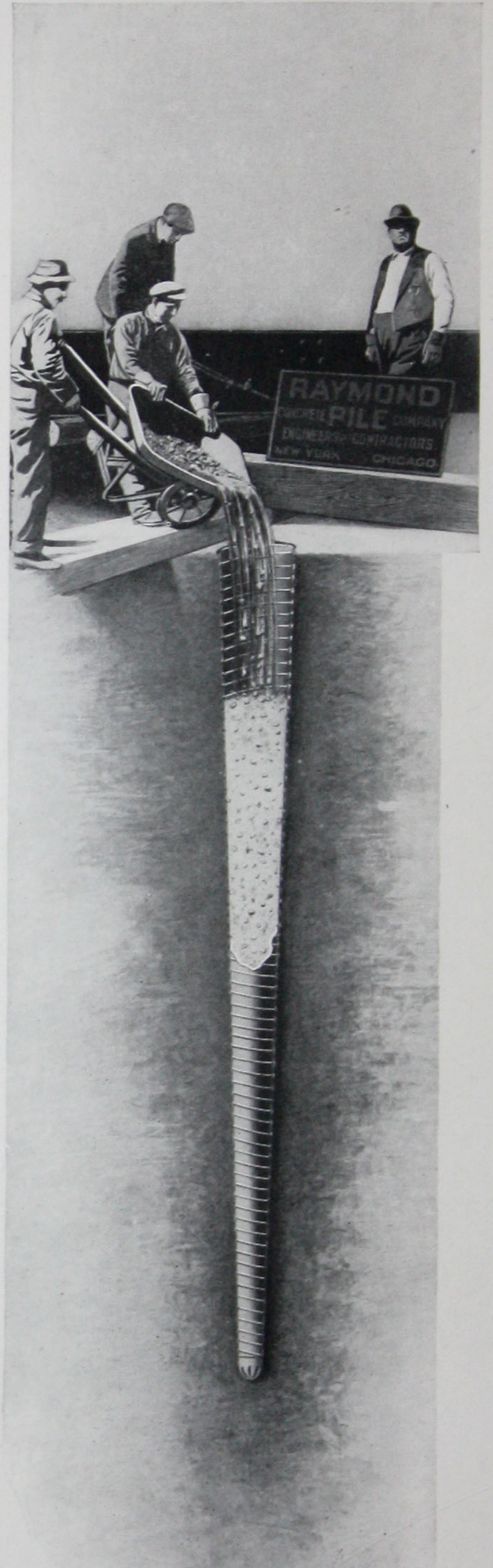


Figure 8

Pouring concrete into the steel shell or form. The shell remains in the ground, protecting the setting concrete.



Track Elevation Work — Chicago, Rock Island and Pacific Railroad Company — Chicago

Points of Raymond Superiority

HAVING thus followed each principal step in the placing of a Raymond Pile, your attention is directed to the following points of superiority and advantage over wood piles:

1. Absolute permanency; not being subject to decay or to the attacks of wood borers and destroyers — a point which does not admit of argument.
2. Economy, because of greater carrying capacity — meaning a less number of piles for a given load.
3. Smaller and lighter footings, because of decreased number of piles.
4. Decrease in total load to be carried, because of decreased weight of footings.
5. Practical elimination of shoring, underpinning, sheeting, pumping and deep excavation and the reduction of masonry.
6. Due to decreased number of piles and consequent reduction in width of wall footings, the center line of columns can be brought nearer to the building line.
7. Important saving in time.

The claim to greater carrying capacity rests upon several points:

- (a) Greater size, therefore greater displacement.
- (b) Greater taper, therefore greater frictional value per square foot.
- (c) Perfect shape, therefore perfect contact with the ground at every point.
- (d) Possibility of inspection after driving, hence the ability to load to full capacity, instead of making a large allowance for inefficiency as in the case of wood piles subject to injury by over-driving, telescoping, departing from the vertical and like defects, none of which are discernible at the moment when correction is possible.
- (e) Decreased length of pile as a natural consequence of greater size and taper.

The advantages of smaller and lighter footings, as mentioned in Items 3 and 4 above, where these results can be secured without sacrifice of efficiency, are too obvious to require detailed discussion.

The permanency of concrete piles, regardless of moisture conditions, naturally eliminates the excavation, sheeting, shoring and pumping necessary, in the case of wood piles, to reach a cutoff below water level, since the concrete pile heads can be left at an elevation only sufficiently below the floor line to permit of the proper distribution of loads.

All designers will appreciate the advantage of keeping their column center lines as near as possible to the center line of the wall, thus reducing, and in many cases avoiding, expensive cantilevers. This is no small consideration when wide footings and limited property lines result in eccentric loads which cannot be otherwise provided for.

The principal reasons for the saving in time mentioned under item seven are:

- (a) The smaller number of piles required.
- (b) The reduction in the amount of excavation, shoring, sheeting and pumping.
- (c) The reduction in quantities of footings or masonry.
- (d) The manufacture of the pile in place, from materials readily procurable in all localities, and the limit of manufacture to the actual number and exact length of piles required. There is no delay for cutting and trimming trees, hauling to shipping point, transporting for great distances by rail or water and delivery to the job, perhaps only to find that the piles are too long or too short.

There is no business in which the expression, "Time is money," more truly applies than in building construction, since a large part of the investment usually represents borrowed money; therefore, no argument is necessary to show that to reduce the time of construction is to reduce the cost to owner and to contractor as well.

Rapidity of work is always more or less governed by local conditions, such as the character of the soil to be penetrated and the length and spacing of the piles. It is, therefore, impossible to give accurate figures that will apply to all conditions under which concrete piles are placed. The extent of the influence of local conditions is indicated by the wide variation in the number of Raymond Piles that can be placed by one driver per day, this number varying from five to forty.

Concrete Pile Classifications

Concrete piles are of two distinct types:

1. Concrete piles which are made in place, commonly referred to as "cast-in-place" concrete piles.
2. Concrete piles which are cast in molds and then driven like wooden piles and are referred to as "pre-cast" concrete piles.

"Cast-in-place" piles are further divided into two classes:

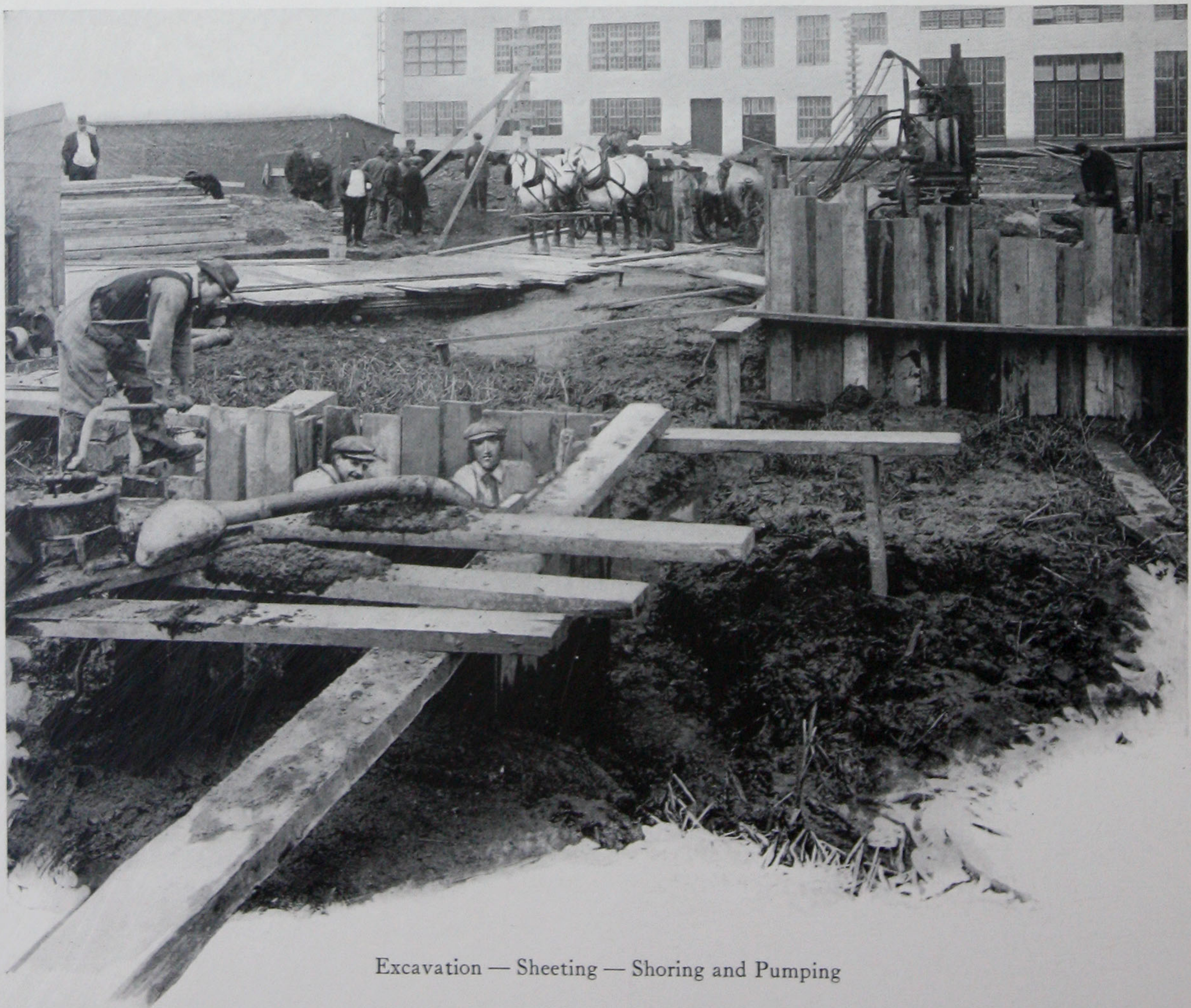
- (a) Those in which a form is left in the ground to preserve the integrity of the finished pile, and
- (b) Those in which the concrete is placed by means of a *temporary* driving form which is removed before the concrete hardens and leaves the pile confined *only* by the loose earth. The green concrete is then, obviously, subject to the admixture of foreign materials, excess of water, and distortion due to strains set up by soil pressures and the *driving of adjacent piles*.

Considering first the cast-in-place type: The Raymond Pile is the *only* Concrete Pile having a permanent form (or shell) which remains in the ground. This feature, as we shall endeavor to demonstrate in the following pages, is essential to perfect and dependable results. The province of the shell is manifold:

1. To serve as a form for the piles — remaining permanently in place.

2. To prevent the admixture of foreign substances with the concrete, and to protect it from excess of ground water during the cement setting period.
3. To retain the original moisture in the mixture until the concrete is thoroughly hardened.
4. To prevent distortion by external pressure, due to the driving of adjacent piles or accumulated pressures from displacement by the pile itself.
5. To retain perfectly the displaced earth forming the walls of the cavity, so that there may be no relaxation of the ground and therefore no loss of resistance when the displacing force (the core) is removed.
6. To act as reinforcement of the pile until the concrete shall have attained its maximum strength.

A fair idea of the appearance and general construction of the shell, both before and after driving, may be obtained by examination of the illustrations on pages 8 and 10, but for the benefit of those who may be interested in more particulars as to its construction, the following brief description is given: The shell is made of black sheet steel, lock-seamed and spirally corrugated on a three inch pitch. Inside the corrugating groove is a heavy hard drawn spring steel wire, fitting



Excavation — Sheet piling — Shoring and Pumping



Section of Spiral Shell split in half to show how the sheet steel is grooved over the wire. Note the strength of the section lying on the ground.

exactly into a spiral groove throughout the entire length of the shell and welded at the ends of each section. The purpose of this wire reinforcement is to impart rigidity and stiffness to the shell, sufficient to withstand the pressures set up in the soil, pressures both hydrostatic and due to displacement. The gauge, and, therefore, the strength of both wire and sheet metal may be varied to suit special conditions.

It should only be necessary to point out the functions of the shell, to make clear that, in the cast-in-place type where no shell is used, vital features are sacrificed in order to effect a saving in first cost. This is a principle in construction work which few conservative engineers or architects will approve. *All of the points raised as to the necessity of the shell apply with equal force as arguments against its omission.*

We doubt whether many reputable engineers would countenance the placing of concrete in the bottom of a sixteen or eighteen inch trench, twenty-five or thirty feet below ground level, with no means of examining the bottom or side walls; or permit the removal of the forms immediately upon the pouring of the concrete, and depend upon such a wall to sustain a load of fifteen to eighteen tons per square foot in addition to its own weight, even should there be indications of rock at its base. The average engineer would insist upon satisfactory answers in his own mind to the following questions:

1. To what elevation would water or other semi-fluid rise in the excavation?
2. How much mud would slough off the edges to become an ingredient of the concrete?
3. How much of the original moisture in the mix, if the ground were dry and the form immediately removed, would be lost from absorption by the surrounding soil?
4. How much had the setting concrete itself been disturbed by the drag of the form between it and the ground?



Showing the construction of the Spiral Shell

He would probably wish knowledge, and remain in doubt, concerning many other things which would continue open questions until the structure was fully finished and completely loaded. Even then, should the results be unsatisfactory, it would be difficult, if not impossible, to locate the weakness and economically remedy the defect. A careful analysis of the above suggestions should make clear their pertinence to the subject of piles cast in place with an immediately removed form.

Pre-cast piles have a large and useful field in the construction of docks, bulk-heads and other marine structures, and are frequently used in foundation work. Usually a water jet is used to secure the desired penetration of a pre-cast pile. It avoids the excessive abuse necessitated by driving.

In the placing of pre-cast piles by means of the jet, great care must be used to avoid the undermining of adjacent foundations. This introduces a factor which is entirely eliminated in the driving of the Raymond Concrete Pile. Furthermore, it is apparent that a steel form will stand much greater abuse in driving than will a reinforced concrete member.

The pre-cast pile can scarcely be said to be economical, since it is necessary to determine from four to six weeks in advance of driving just what length of pile to cast, and experience shows that this pre-determination can never be accurately made. This naturally results in either excessive expense in splicing the piles or great waste in cutting them off. If the material to be penetrated were pure sand, doubtless any ordinary length of pile could be sunk until its head had reached the desired elevation, notwithstanding the fact that a shorter pile would have served the purpose if driven to necessary resistance. In such a case the lack of economy would still be apparent.



A live load of twenty-two full-grown men on one 30-foot shell

If pre-cast piles are driven without the use of the jet, it is necessary to cushion and protect the head to avoid damage to the pile structure. This cushion or protection naturally absorbs a large part of the energy of the hammer blow and consequently prevents any accurate calculation of the carrying power of the pile through a record of the penetration under each blow. Since it is impossible to subject the pre-cast pile to the same solid driving shock as the made-in-place pile, it follows that it is impossible to develop the same resistance to static load. Elaborate tests have been made by railroads and other large corporations proving this to be so. They show that a made-in-place tapered concrete pile carries a greater load than a pre-cast pile driven in the same soil in the proportion of 100 to 70. This factor alone, disregarding the items of waste due to the impossibility of predetermining the lengths and the injury to the piles in transporting and handling is sufficient to prove the economy of Raymond Piles over pre-cast at a materially higher price.

The Prevention of Distortion

IF you have ever seen a pile core or a pile driven twenty or thirty feet into the ground and immediately withdrawn, you have noticed that the earth at once attempts to return partially to its former position. Should soft concrete be poured into the opening thus left, the returning earth is apt to cause distortion before the concrete sets, as has frequently been proven by the exposure of concrete piles made without a protecting form. (See Engineering Record, 3-22-13.) Because of the differences in density and, consequently, in resiliency, of various soil strata, this distortion is apt to be very unequal, diametric measurements varying in some cases from thirty-six to three or four inches from an original diameter of fourteen to sixteen inches.



North Hill Viaduct, Akron, Ohio. Harrington, Howard & Ash, Engineers.

Since the bearing value of any pile is determined by its resistance to the blow of the hammer, any reliable calculation of this value must of necessity depend upon the displaced and compressed soil maintaining the exact position and density to which it has been forced by the displacing body. This is, of course, on the assumption that the pile is not point bearing, acting as a column without side friction — a condition so rare as to merit little consideration.

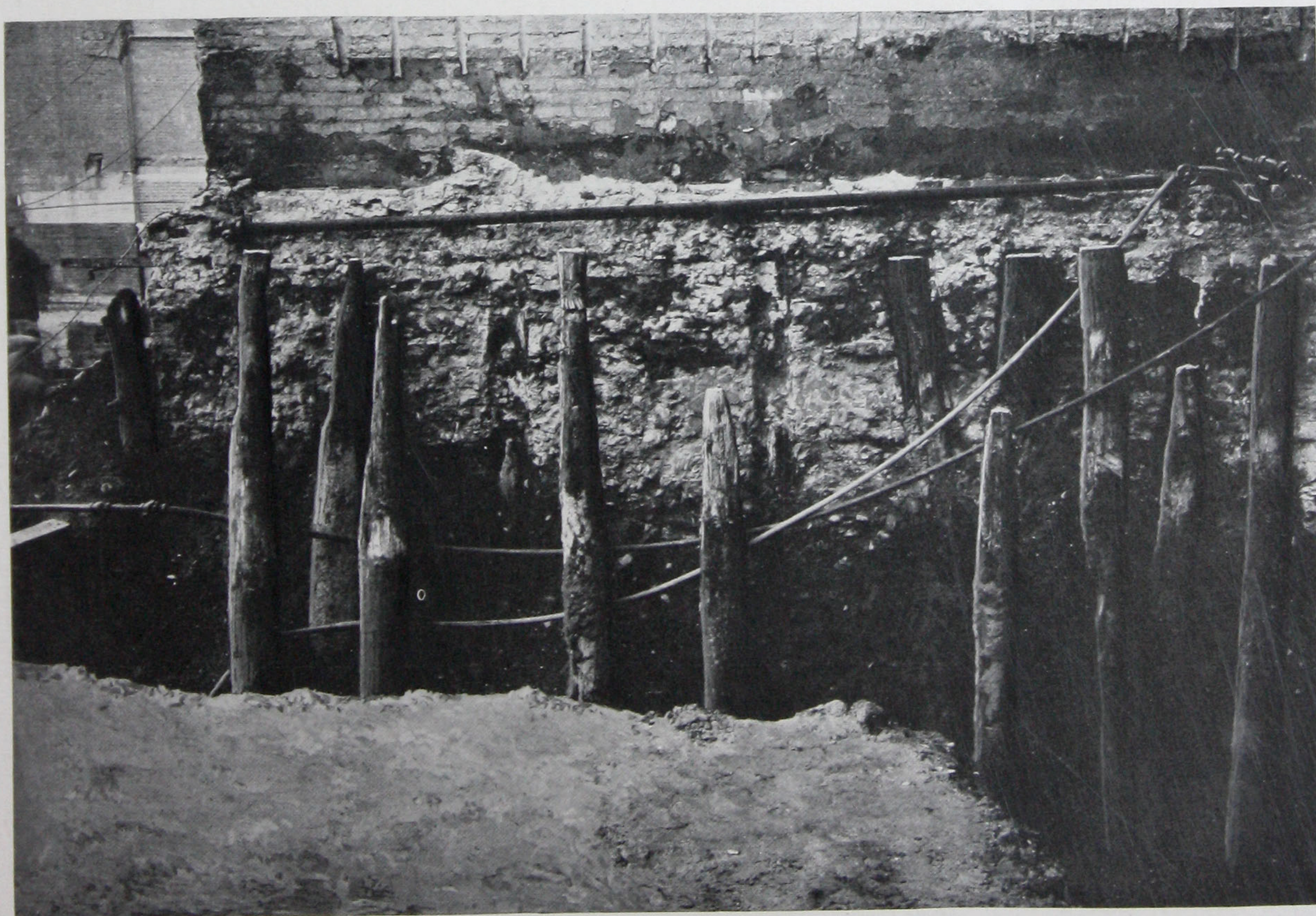
All cast-in-place piles are made by means of a driving core or a pipe which is withdrawn before or immediately after the concrete is placed. Therefore, in order to secure the full frictional value of the pile, the substance which in driving is opposed to the ground, and whose friction with the ground has been the greatest factor in developing the resistance to the hammer, should remain in place and should be sufficiently rigid to maintain the developed resistance until the concrete has hardened sufficiently for that purpose. The relaxation of the ground while the concrete is hardening must be prevented, and the compacted condition of the soil must not be disturbed, if calculable results are to be obtained. The forcible removal of the ground-restraining force while the concrete is setting, and the reliance upon the concrete itself to fill the void thus made and overcome the elasticity of the ground, cannot fulfill this condition.



What chance excavation revealed. Every pile a perfect pile.

With the Raymond System this object is accomplished by the use of the left-in-place steel shell, reinforced to a degree which examination of each pile shows to be adequate for the purpose. This inspection occurs after every operation is complete, except the pouring of the concrete. Thus the hazards of distortion and loss of resistance are eliminated and the size, shape and value of the pile become and remain known quantities.

Should it appear upon inspection that a shell has been torn or otherwise injured in driving or should unsuspected and unusual pressures develop at some point, resulting in the entrance of water or other foreign substance, the defect can be immediately remedied by the insertion of another shell before the concrete is poured. The Raymond Pile is the only concrete pile which offers such opportunity for timely inspection. Any distortion that may occur in a pile made in place without a form, or with only a temporary form; any fracture that may occur in the driving of a pre-cast pile must of necessity remain hidden, subsequent settlement, perhaps, calling attention to the existence, though not to the extent nor to the nature of the concealed fault.



From a photograph showing condition of the wood piles exposed in excavating at the Southwest corner of Bethune and Washington Streets, New York, in 1924. The curb elevation was 110.8. The piles when placed were cut off at elevation 101 — the water level at that time. The present water level is 87.1. When excavation was begun water was encountered at elevation 93, but when wood piles were exposed and several had been pulled out, the water at that elevation disappeared and the level dropped to 87.1. For a distance of $3\frac{1}{2}$ feet below original cut off, the piles were so badly rotted that they could be pulled apart with the fingers. This is a very startling illustration of the unreliability of wood piles cut off at what might appear from ordinary investigation to be a definite moisture level.

The Value of the Taper

A PILE foundation is generally suggested by the absence of stable soil within a few feet of the surface of the ground or at the bottom of such footing as would naturally be used to secure proper bearing. The pile carries its load partly by friction with the ground throughout its entire length, and partly as a supported column with its lower portion driven firmly into underlying stable soil or to rock. It is frequently the case, however, that the soil is of the same nature to any practical limit of depth and then it is merely a question of developing a frictional bearing to sustain the required load.

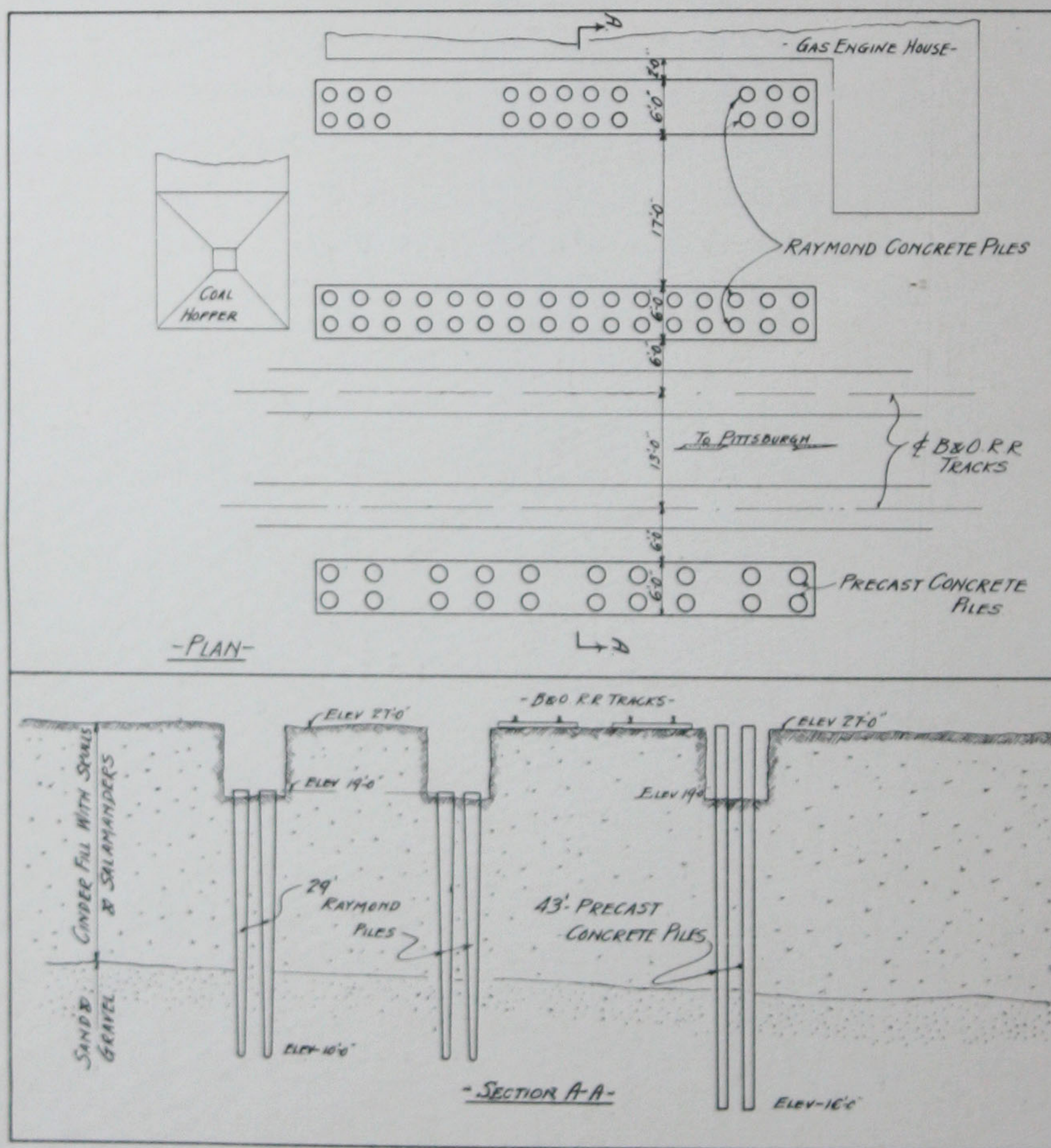
In some soils this frictional bearing is greatly assisted by the compacting and the consequent increased density of the ground resulting from the displacement by the piles themselves.

In friction soils tapered piles afford a better carrying capacity than do straight piles.

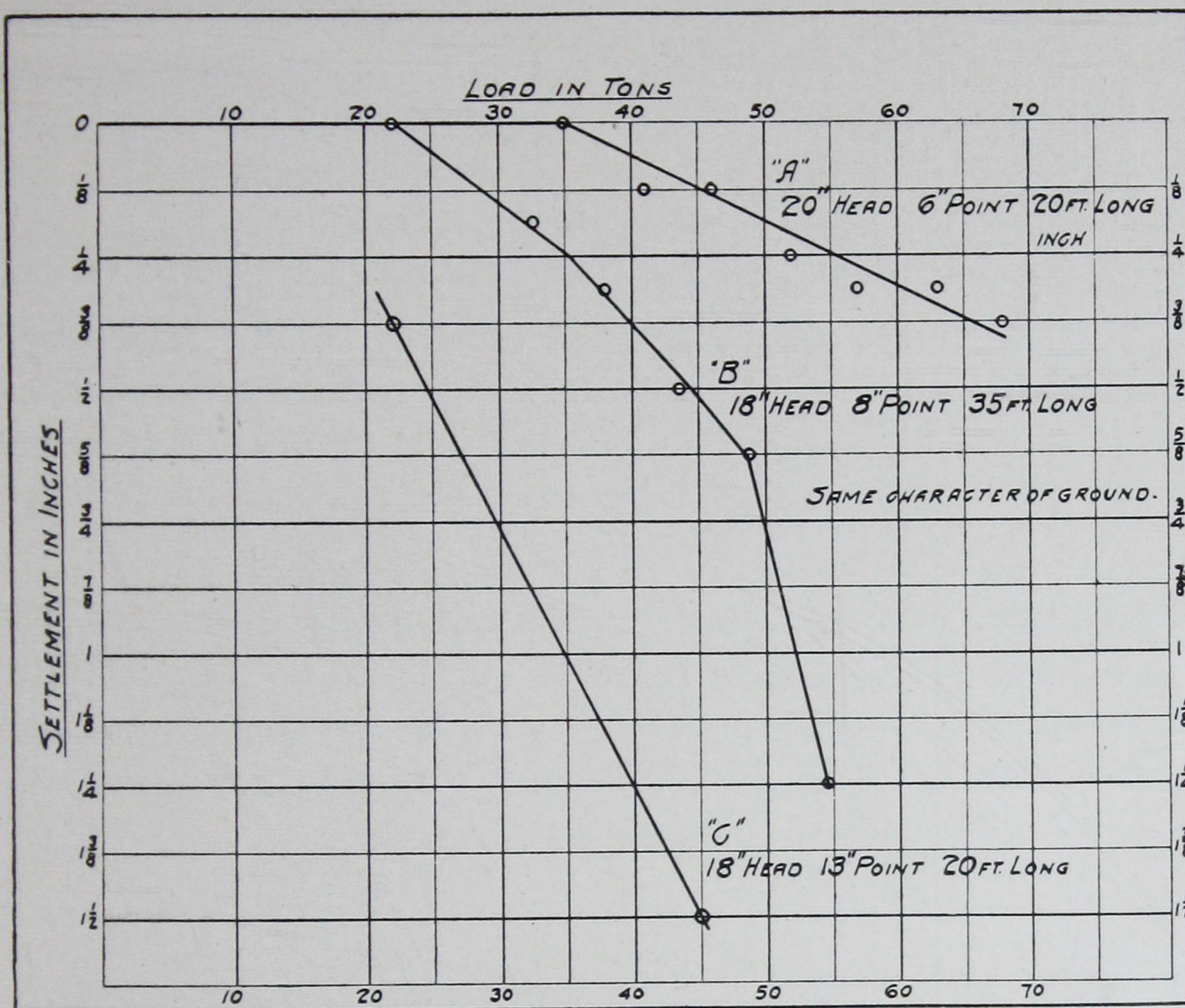
Raymond Concrete Piles possess extreme taper. They offer maximum resistance for a given length. While we recognize the value of straight piles under certain conditions and recommend and place them when such conditions exist, in a great majority of cases the tapered Raymond Piles have proven the more effective.

Our conviction that the tapered rather than the straight pile has the advantage in carrying capacity is based on data derived from:

1. A comprehensive record of the resistance encountered in driving.
2. An extensive series of loading tests, during which the real carrying power of the pile has been checked with the driving resistance.



Tapered Piles vs. Parallel-sided Precast Piles
Crucible Steel Co., La Belle Works, Pittsburgh, Pa.



Curve indicating increase in resistance due to increase in taper

increased surface area afforded increased friction and, consequently, increased carrying capacity. (See curve on cut.)

To make sure on this point, two piles, each twenty feet long, were driven within a few feet of each other. One core, "Core A," was six inches in diameter at the point and twenty inches in diameter at the top, while the other core, "Core C," was thirteen inches in diameter at the point and eighteen inches in diameter at the top. "Core C," with the large point, drove fairly hard from the start, and required nine hundred and forty-four blows of the steam hammer to secure a penetration of twenty feet. "Core A," with the smaller point, started easily and required only eight hundred and seventy-five blows to secure twenty feet of penetration.

At the expiration of about a month, both piles were loaded and carefully tested. The test showed that the pile with the greater taper carried a proportionately greater load, showing no appreciable settlement up to sixty-five tons, whereas the straight pile showed the same settlement with a load slightly more than twenty tons. This result is particularly interesting, in view of the fact that the engineer who made the tests did so for the specific purpose of demonstrating that a straight pile had a greater carrying capacity than a tapered pile. The results of these tests have been repeatedly confirmed in the course of our experience.

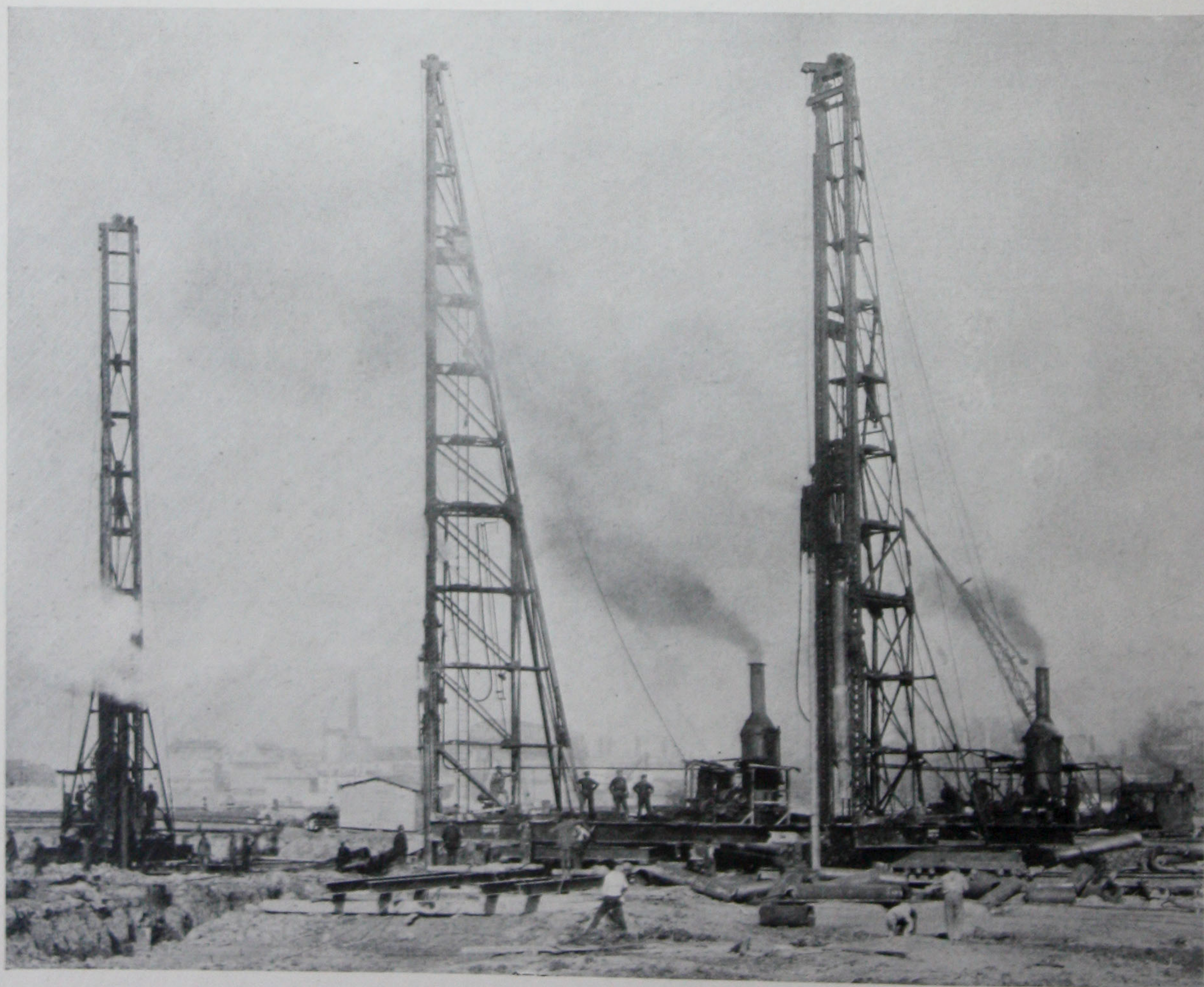
Since in placing a Raymond pile the weights of the driving core and hammer are constant, it is possible to determine, by observation of the penetration under

The record of a test conducted to ascertain the relative carrying capacity of straight and tapered piling is given below.

This test was made under the supervision of a prominent engineer, who contended that, for the soil in question, a straight pile possessed certain advantages over a tapered pile. This engineer's attitude was based on the belief that in-

each blow of the hammer and noting the final resistance as measured in average penetration per blow for the last inch, the safe load for which the pile can be relied upon. The records thus taken and the results analyzed in the light of experience with soils of the same general character constitute a method of measuring resistance with practically as much certainty as testing the pile with an actual load. Furthermore, each particular pile is in actual practice subjected to this test, so that definitely known bearing values are established at each point where loads are concentrated. Load tests are sometimes made, but in the majority of instances the driving test above described is of more value, since it is applied to each individual pile and does not entail the delay or expense incident to loading for test purposes only.

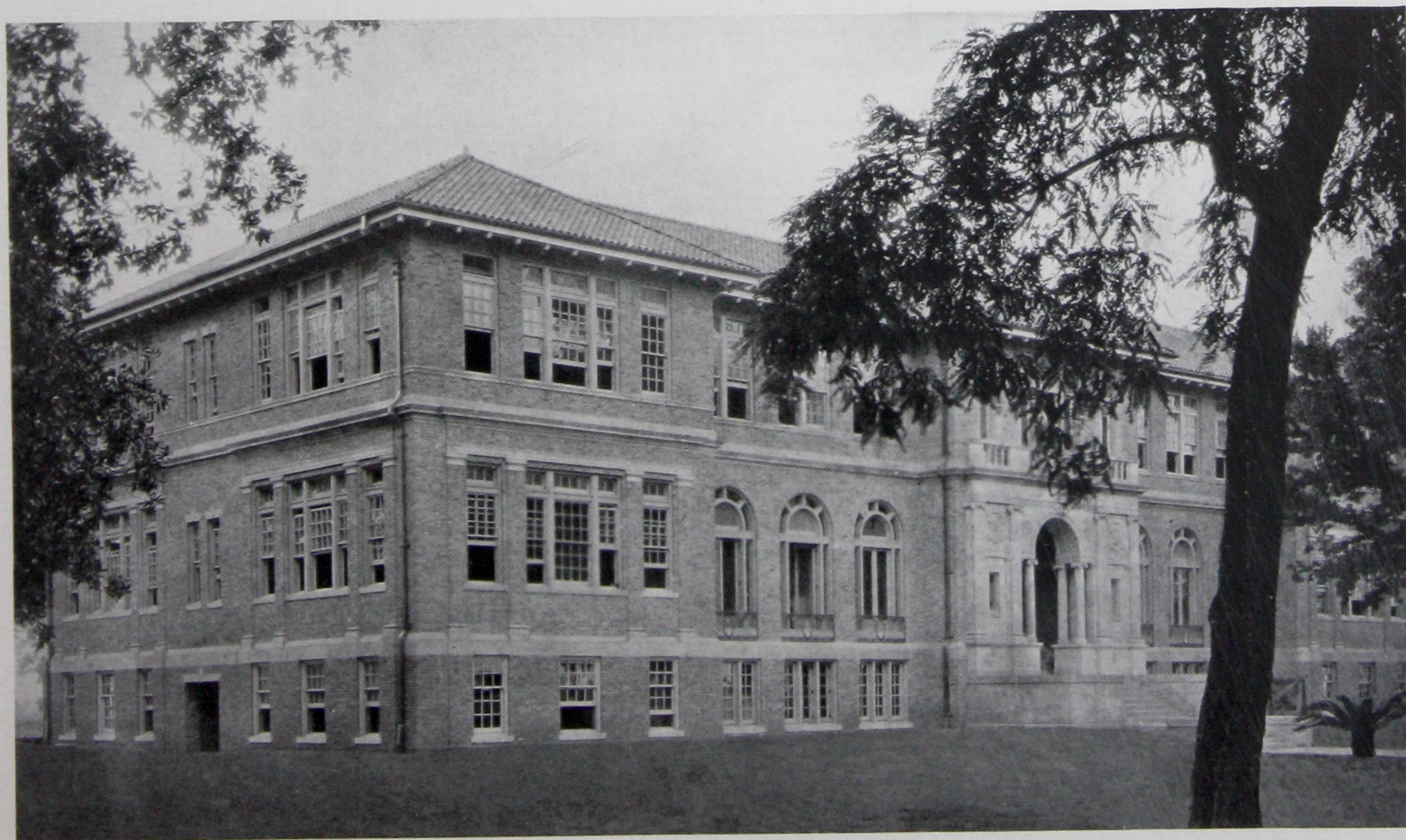
There are conditions under which a pile of uniform diameter throughout its length has advantages. These pertain to piles which penetrate to rock or hard pan through very soft or semi-fluid material. Such piles may be considered solely as columns. To meet these conditions we recommend a pile with very slight taper, having a large point bearing area.



A group of three 85' all-steel drivers operating at the Ford Rouge Plant, and placing composite piles to a length of 80 to 100 feet below ground surface.

The failure to appreciate the greater carrying capacity of a tapered pile has resulted in the increased cost of many concrete pile foundations, for the reason that contracts are often awarded solely on the basis of the lowest price per lineal foot. It is well known that the "per foot price" of piling, whether wood or concrete, is in a measure inversely proportional to the number of feet involved in the contract. It is, therefore, obvious that the bidder who bases his price per foot on the use of a pile which is of uniform diameter throughout its length realizes that, unless the site overlies hardpan or rock, a very much greater average length of pile can be secured than must be considered by his competitor who bids on a tapered pile. The price per foot is fixed accordingly, with the mental reservation on the part of the non-tapered pile bidder that the owner is going to be called upon to pay for a great many more lineal feet of his pile to secure a given carrying capacity than if the tapered pile is adopted. For instance, it is quite conceivable that tapered piles to develop a thirty-ton load might average twenty feet in length, and that non-tapered piles to be driven to carry the same loads might average thirty feet in length. Under these conditions, the economical price of a non-tapered pile should not exceed sixty-seven per cent. of the cost of the tapered pile.

The record of a test made of a thirty-five foot pile (see curve "B," page 20) is of interest as showing the economy of tapering piles. This pile measured eight inches at the point and eighteen inches at the top. On account of its less taper, it was possible to secure a penetration some fifteen feet deeper than with the twenty foot pile having a greater taper. But, notwithstanding the increased length, its carrying capacity under load was not as great as that of the short pile.



Masonic Home, Alexandria, Louisiana.
Jones, Roessle & Alschner.

Dimensions of Standard Raymond Concrete Piles

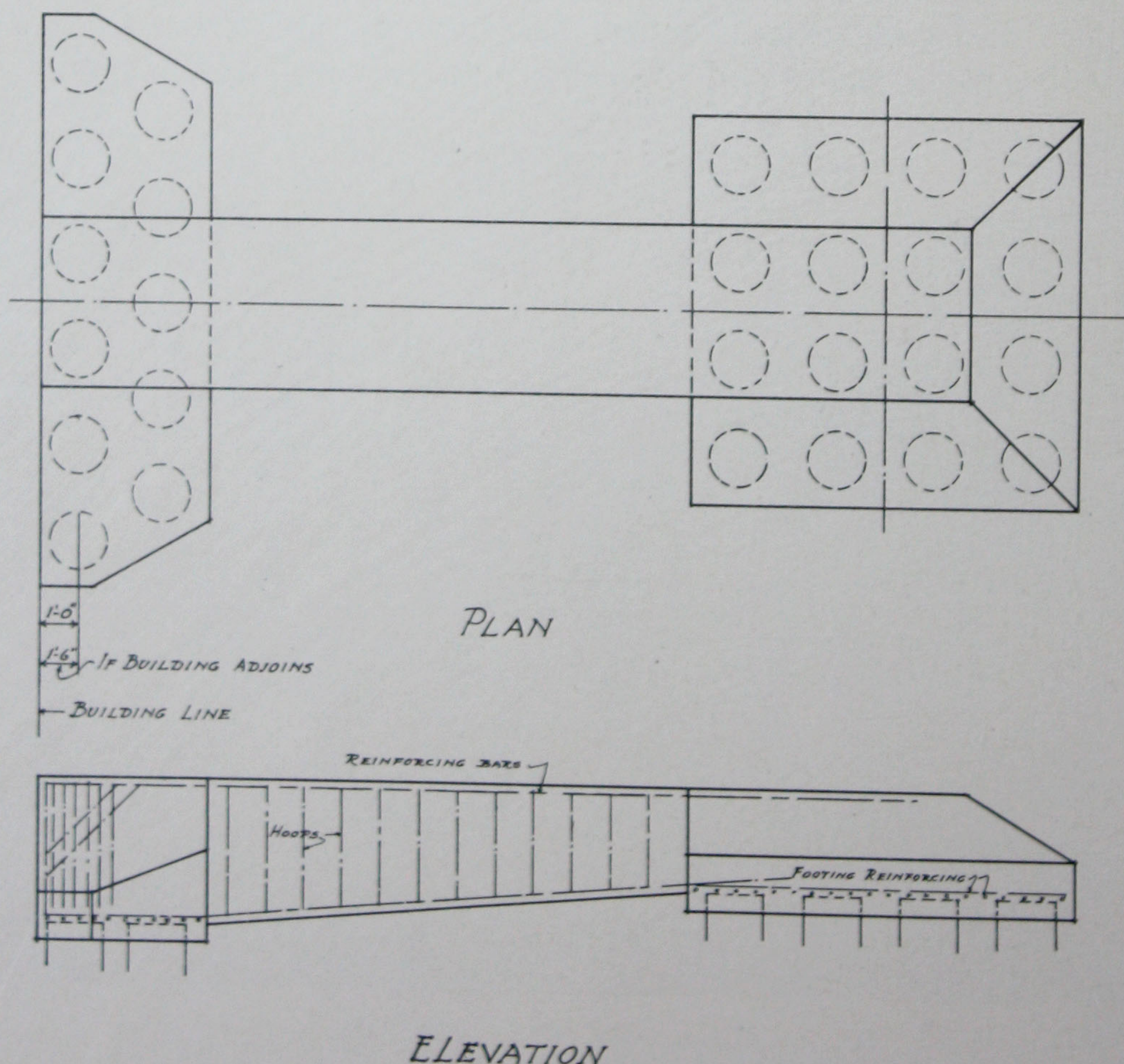
STANDARD Raymond Concrete Piles are installed by use of pile cores eight inches in diameter at the point or bottom and twenty inches in diameter at thirty feet from the point, an increase of four-tenths of an inch per foot of length.

A pile twenty feet in length, for example, would therefore be sixteen inches in diameter at its top, while one thirty-seven feet in length would have a top diameter of twenty-two and eight-tenths inches.

The present limit of length for a *Standard* Raymond Pile is thirty-seven feet six inches.

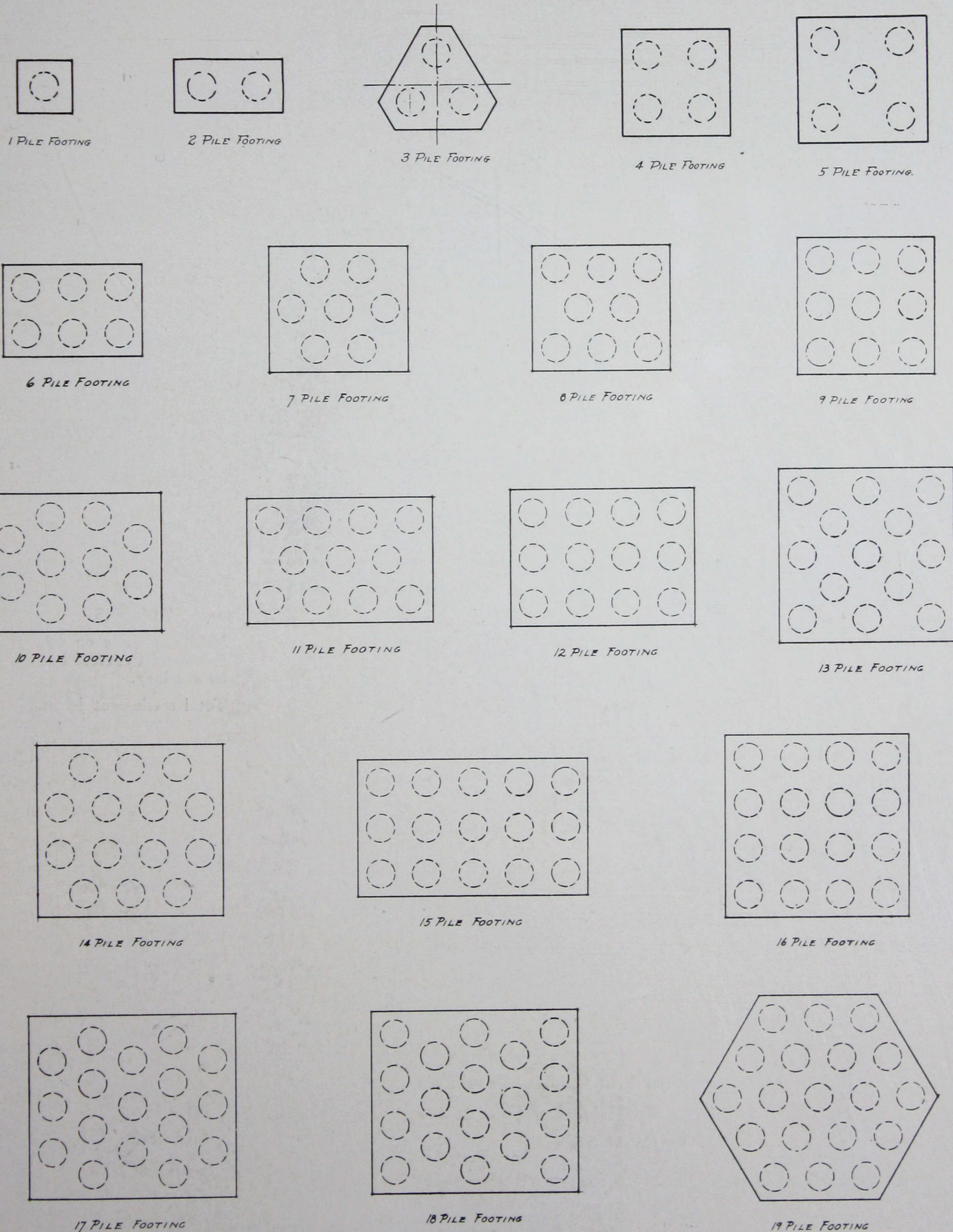
Where conditions are such as to require piles of greater length, we suggest that the matter be taken up with our nearest office, and a type of pile suitable for the particular situation will be recommended.

We call your attention particularly to the Raymond Composite (wood-concrete) Pile, a description of which will be found in a separate bulletin which will be mailed upon request.



Typical Pile Footings

This chart gives a general idea of customary arrangement of piles in typical concrete footings.





130,000 POUND TEST LOAD ON
ONE STANDARD RAYMOND CONCRETE PILE
PILE 2818 - SETTLEMENT IN.
TEST MADE FOR UNIVERSITY OF ROCHESTER, ROCHESTER, N.Y.
CHICAGO RAYMOND CONCRETE PILE CO. NEW YORK
JULY 25 1923

65 TONS

130,000 pounds, on one
Raymond Concrete Pile
28 feet, 8 inches long.

Total settlement $\frac{1}{16}$ inch.

60 TONS

120,000 pounds on one
Raymond Concrete Pile
38 feet, 0 inches long.

Settlement - NONE.



TEST LOAD ON ONE STANDARD
RAYMOND CONCRETE PILE
THE NEBRASKA POWER COMPANY
CHICAGO, ILL.
LENGTH OF PILE 38 FT.
LOAD IN TONS 60
SETTLEMENT NONE
DEC 24 1923



70 TONS
140,000 POUND TEST LOAD ON
ONE RAYMOND CONCRETE PILE
Length of Pile 30 feet. Settlement Only 1/4 inch.
Claridge Apartments
Owner - BURTON INVESTMENT CO.
General Contractors - FLEISHER CONSTRUCTION CO.
Piling Contract - THE OAKES CO.
SPEERSJEVNE
CHICAGO RAYMOND CONCRETE PILES

70 TONS

140,000 pounds on one
Raymond Concrete Pile
30 feet long.

Total settlement $\frac{1}{4}$ in.

67½ TONS

135,000 pounds on one
Raymond Concrete Pile
30 feet, 10 inches long.

Settlement - NONE.



67½ TONS LOAD ON
ONE STANDARD RAYMOND CONCRETE PILE
PILE LENGTH 30'-10"
FINAL PENETRATION 1/2" PER BLOW
TOTAL SETTLEMENT NONE
RAYMOND CONCRETE PILE COMPANY
ENGINEERS - CONTRACTORS
NEW YORK - ATLANTA - CHICAGO
FOR BEAUMONT HOTEL BUILDING - BEAUMONT, TEX.
MANN & STERN, ARCHITECTS.
LITTLE ROCK, ARK.
CS LAMBIE COMPANY - CONSTRUCTING ENGINEERS
DENVER - BEAUMONT - PUEBLO

Working Loads

WE are often asked what loads to figure for Raymond Piles. In the majority of cases, they are driven to carry a working load of thirty tons each. In some cases, where it is impossible to secure proper resistance, it is necessary to reduce this to twenty-five or even twenty tons. In other cases loads of thirty-five and forty tons are safely carried.

Many tests have been made in soils of greatly varying character. Illustrations of some of these tests are shown on page twenty-six. In view of the wide variation in soil conditions, we suggest that a conference be arranged with our nearest office, in order that we may investigate the site and make studied recommendations.

In calculating the resistance to penetration the following "Engineering News Formula," based on using a steam hammer, has been found most satisfactory:

$$L = \frac{2WH}{S+0.1}$$

{

L = Safe load in pounds.

W = Weight of falling parts in pounds.

H = Drop in feet of falling parts.

S = Final penetration per blow in inches.

A No. 1 steam hammer has a weight of five thousand pounds falling thirty-six inches.

A No. 2 steam hammer has a weight of three thousand pounds falling thirty inches.

The carrying capacity of Raymond Piles is not a matter of guesswork or speculation, but is susceptible of computation and demonstration. In two notable instances, chief engineers of great railroad corporations have made exhaustive tests of Raymond Piles in comparison with wood piles, pre-cast concrete piles and concrete piles made in place without a permanent form. A careful analysis of reports of these tests shows that Raymond Piles carried from thirty to fifty per cent. greater load, without material settlement, than any other type of pile tested, with the result that the contracts for all piles used for the work to which these tests were preliminary, were awarded to us. This greater carrying capacity of Raymond Piles, considered in connection with the fact that a given load will be carried at a less average length than with other types of piles, would justify a much higher price per foot, should a comparison be made on that basis.

It should also be pointed out in this connection that Raymond Piles can be placed on closer centers than piles of the shell-less type. This results in a material saving in cost of footings, reinforcement and excavation.

Since the determination to use piles is primarily the result of a desire to guard against foundation failures, it is indefensible to select the type of foundation pile solely on the question of initial cost. To omit any safeguard in order that the price may be reduced does not mean a real saving to the owner, but on the contrary holds possibilities of great loss. *That type of pile which presents the greatest assurance of meeting the conditions which demand piles is the economical selection.*



SCHENLEY HIGH SCHOOL

PITTSBURGH, PA.

EDWARD STOTZ, ARCHITECT.

RECORD OF FIVE SINGLE PILE TESTS

120,000 LBS. PLACED ON EACH PILE

TEST NO. LENTH SETTLEMENT

1	30' 7"	3/16"
2	37' 6"	1/16"
3	36' 1"	3/8"
4	29' 4"	1/16"
5	30' 7"	3/16"

THIS PICTURE SHOWS LAST
PILE TESTED MAY 20, 1915

Raymond Concrete Pile Co.

NEW YORK PITTSBURGH CHICAGO

A record of five piles tested separately

Cost of Raymond Piles

RAYMOND Concrete Piles are made in place and not sold by the foot f. o. b. cars. Consequently it is impossible to quote prices without knowing the conditions under which the work is to be done.

For even approximate prices it is necessary to know the number and lengths of piles required, the approximate spacing, soil conditions, accessibility of the site with reference to railroad siding, cost of concrete materials and labor conditions.

It is therefore highly desirable that the necessary information be given to our nearest office and an opportunity afforded for an examination of the site.

Specifications for Raymond Concrete Piling

WE are frequently asked by architects and engineers who wish to be certain of securing satisfactory concrete pile work to submit specifications for Raymond Piles. If "*Raymond Concrete Piles*" are called for, this is, of course, sufficient. On the other hand, if it is for any reason inadvisable to name them specifically, the following specifications will cover them:

"Concrete piles shall be of a type specifically approved by the architect or engineer, and shall be placed in the following manner:

"A collapsible steel mandrel or pile core eight inches in diameter at the small end and twenty inches in diameter thirty feet from that point shall be incased in a spirally reinforced steel shell and driven to a proper penetration. The pile core shall then be collapsed and withdrawn from the shell. Before placing the concrete, each shell shall be inspected and, being found perfect, shall thereupon be filled with concrete placed in accordance with the best practice;"

or

"Molded-in-place piles shall be of a type suitable for the conditions and subject to the approval of the Architect or Engineer. They shall be formed in casings left in place, which shall be of sufficient strength to prevent distortion or bulging after mandrel has been withdrawn and while the cavity is being filled with concrete, or during the driving of adjacent casings."

Reinforcing Raymond Piles

WHERE Raymond Concrete Piles are used for compression loads only, they are usually not reinforced. Should the material penetrated have a tendency to travel horizontally or slip, reinforcement is placed in the shell prior to the pouring of the concrete. This is accomplished without change of method or loss of time.

Wood Piling and Shifting Water Levels

THAT wood piling will be permanent if constantly saturated or submerged, has been proven by the specimens exhumed in Europe by archaeologists and others. But the difficulty of maintaining the saturation of piling is a problem that is becoming more and more serious, due to certain unavoidable causes.

In an editorial entitled, "Wood Piling and Ground Water Level," *Engineering-Contracting** says, apropos of this problem:

"A point not so often allowed for as it should be in planning the use of wooden piles is the change in water level that is likely to occur, particularly in large cities, where sewers, subways, and other structures affecting underground water level are continually being constructed. Wooden piling to be permanent must be entirely below water, and engineers plan their permanent pile structures always with this in mind. It cannot be too confidently assumed, however, that piles whose tops are well below water when the foundation is built will still be below water level a few years later.

"This fact is being continually brought to mind by rebuilding work going on in New York, Chicago, and other large cities. Bulkheads built at certain points along the Chicago River of piles capped with concrete, and having the piles submerged when built, now show the pile tops exposed. Changes in drainage conditions have lowered the water level. In tearing down recently a building constructed some ten years ago in Milwaukee on pile foundations, the pile tops were found some three feet above the water level, though when the building was constructed they had been placed below it. The sewerage and drainage work of the intervening years had lowered the original water level.

"The lesson of these occurrences is obvious, for no one can doubt that they represent quite common conditions. Ground water levels depend entirely on drainage conditions, and in cities drainage conditions are seldom the same for any long time. The engineer who puts in permanent pile work, therefore, runs a hazard of having it exposed to rot by succeeding constructions affecting ground water levels, unless he is very certain of his conditions."

**Engineering-Contracting*, Chicago, April 13, 1910.



Section of composite pile excavated and the joint exposed by chipping the concrete to the center of the pile, after having been driven 665 blows with a 5000 pound hammer and loaded to 50 tons with less than $\frac{1}{2}$ " settlement.



A group of over-driven and rotten wood piles exposed in connection with the underpinning job illustrated on page 64.

An article published in *Cement Age** under the heading of "Prevention and Cure of Weak Foundations," not only reiterates the warning conveyed by *Engineering-Contracting*, but goes further in describing some specific instances of buildings settling as a direct result of defective wood piling foundations, impaired by changes in ground water levels.

The writer says:

"As the demand for consistent economy in design and construction of buildings increases, attention is being drawn to the all-important subject of foundations. The settlement observed in many important buildings during recent years and the great cost of the repairs made necessary, to say nothing of the danger and risk involved, have contributed to make a consideration of the subject not only interesting and timely, but of vital importance to those concerned, whether owners, architects or builders.

"For buildings that could not well be founded on solid rock, and whose dimensions did not warrant the use of pneumatic caissons, it has been customary to rest footings upon the heads of wood piles sawed off below the ground water level and spaced to distribute the load according to the estimated safe bearing power. Such foundations were considered economical and satisfactory, and it is only during recent years that the many failures of wood pile foundations raised a serious question as to their economy in important building operations.

"Wood piles form a satisfactory foundation as long as they are below the ground water level, but when the water level lowers and the piles are exposed to the atmosphere, they deteriorate rapidly, often involving serious risks, and invariably necessitating expensive repairs. Such conditions have become much too prevalent, and it is most gratifying to know that modern engineering has developed efficient and economical methods of prevention as well as cure for these dangerous and costly troubles.

"The principal cause for the weakening of wood pile foundations is the changes in underground water levels. In open country the

**Cement Age*, New York, April, 1910.

water table is maintained at a fairly uniform level, because there are no artificial causes to disturb the permanence of the supply. In cities, however, the condition is wholly changed, because roofs and pavements divert the natural surface drainage and underground works often change the course of streams so that the ground water level is subject to marked variations.

"As an illustration of the change of the ground water level and its effect upon wood pile foundations, some cases in New York City may be cited. At the site of the Tombs and surrounding buildings formerly existed a deep fresh water pond, fed by numerous springs. It was called by the Dutch "Kalch Hook" (Shell Point), later corrupted by the English into "Collect," by which name it has since been known. During the construction of the subway on Center Street the tunnel passed through the site of the old Collect Pond and considerable water was encountered, which had to be removed by pumping. The pumps were located about twenty-five feet below the curb, and the pumping operation extended over a period of ten or twelve months.

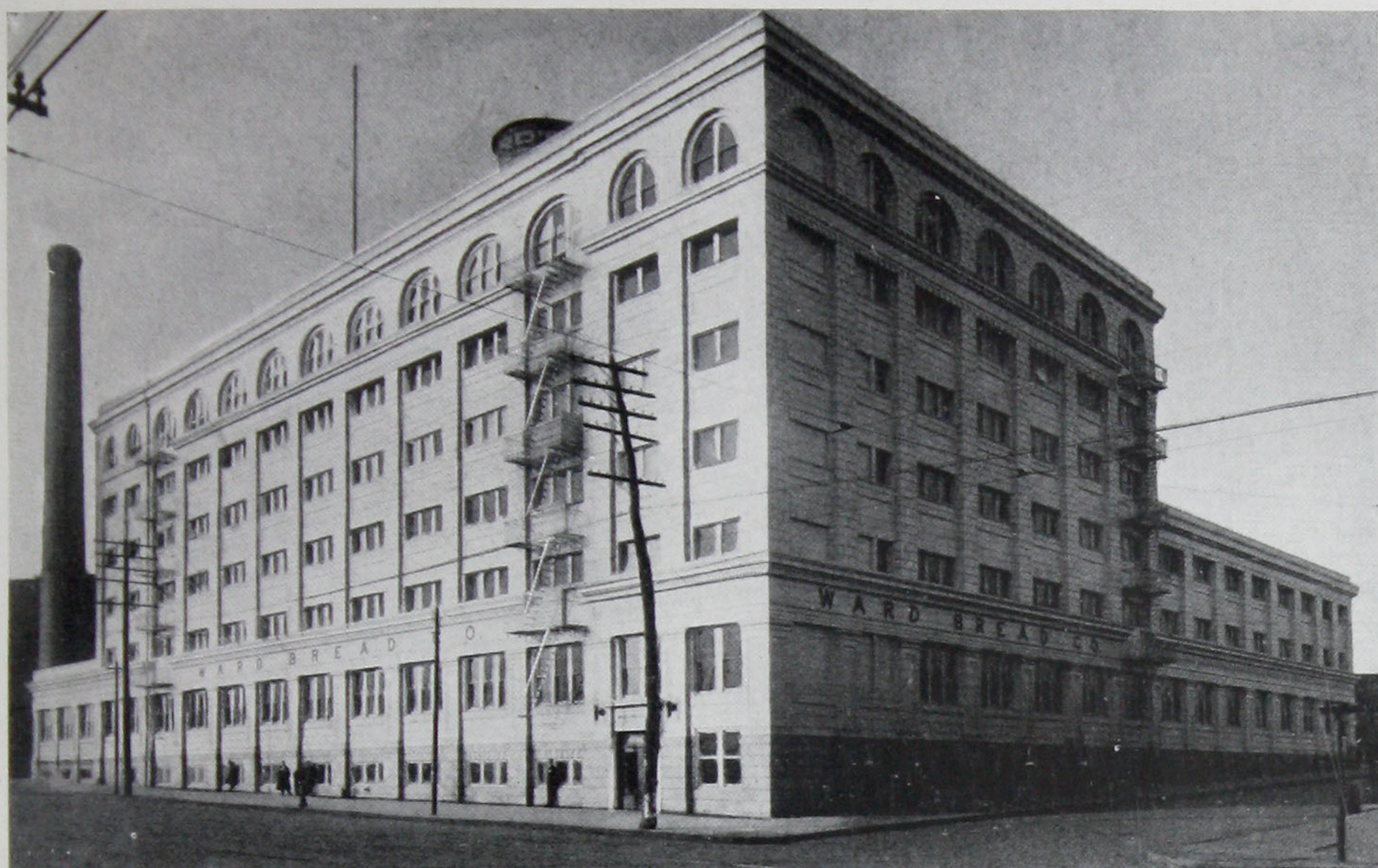
"Near the same street, a seven-story brick warehouse showed evidence of settlement. When the building was erected, about sixteen years ago, the piles were cut off about ten feet below curb level, an elevation which was then below mean ground water level. Since then the ground water level has been lowered from five to ten feet in this locality by heavy pumping and drainage, chiefly in connection with the excavations and constructions for the subway through Center Street.

"Within the last two years the foundations of this building settled about two inches. Investigations showed that the tops of the piles were about eight feet above the present ground water level, and were no longer protected by saturation, so that decay had commenced which might in time seriously imperil the stability of the building.

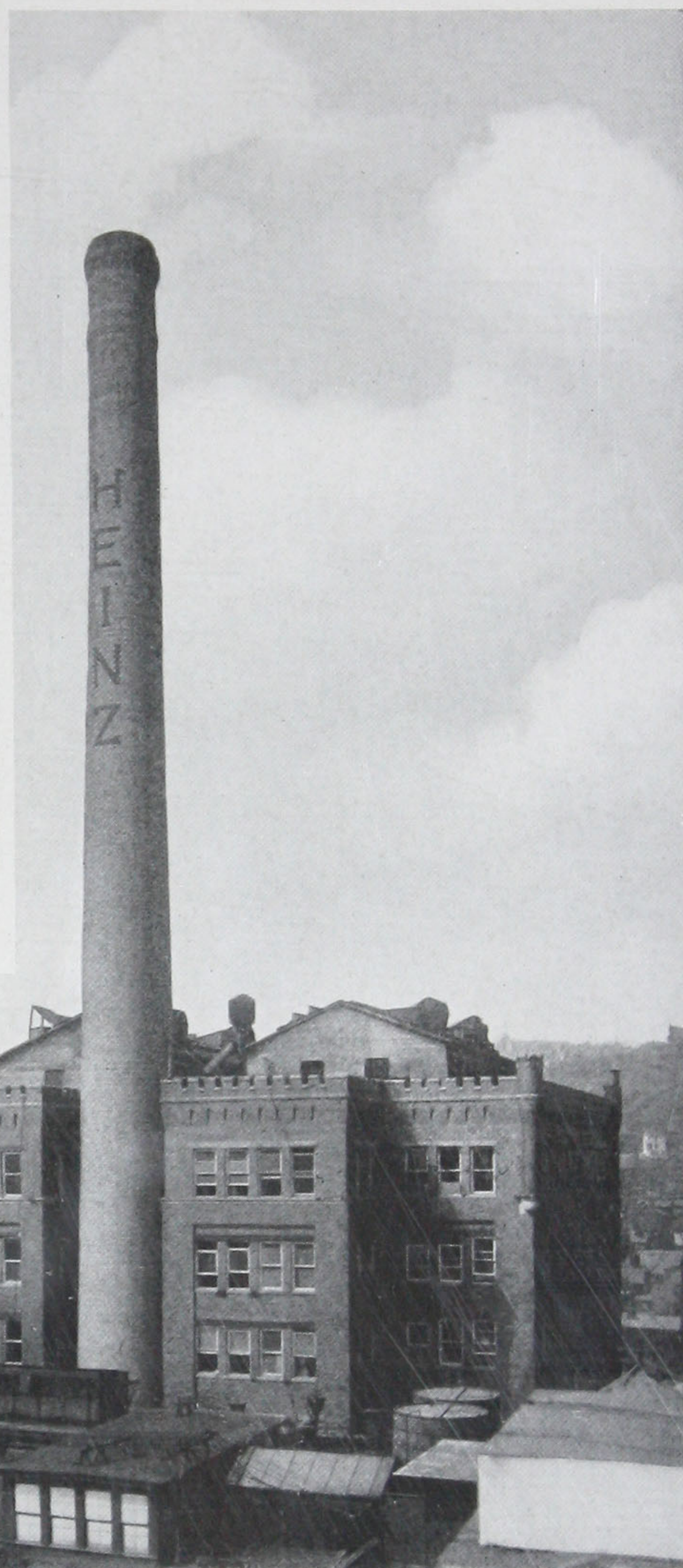
"It is believed that with cessation of pumping for the subway, the lowering of ground water level will not only cease, but may be reversed, so that in time the level may rise part way at least to its former elevation. It was, therefore, considered that the safety of the building would be sufficiently insured by safeguarding that portion of the foundation between the bottom of the concrete footings and the present ground water level, below which the piles are durable and efficient. To accomplish this it was determined to cut the piles down five feet and to extend the present concrete footing down to rest on their lowered tops. This was done at a great expense to the owner, the walls were needled, the earth below them excavated, and piles cut off and new concrete footings placed upon the piles after they had been cut off at the lower elevation.

"A remarkable instance of the lowering of the water level away from pile foundation because of tunnel construction occurred at the old Cambridge Hall Building, Thirty-third Street, directly opposite the Waldorf Hotel. The Thirty-third Street wall of this building was supported on wooden piles. Settlement took place in the building during the construction of the Thirty-third Street crosstown tunnels, which went directly in front of the building.

"After the tunnel excavation had been completed, and the permanent masonry lining built in place, it was thought that the stream which had been flowing into the tunnel the year before would back up and again submerge the piles. The borings, however, indicated that this was not so, for the tunnel had in some manner effectually and permanently diverted the old stream and lowered the ground water level.



Ward Bread Company Building (Tip-Top Bread), New York, N.Y. C. B. Comstock, Architect



Building for H. J. Heinz Company, Pittsburgh, Pa.



Central Bank and Trust Company Building,
Memphis, Tenn.

J. G. Rogers and N. M. Woods, Jr.,
Associated Architects



Sears-Roebuck Company Warehouse, Kansas City, Mo.
Geo. C. Nimmons, Architect

"The roof of the tunnel at this point was in rock and the piles supporting the north wall of the building rested on the rock. When the contract was let for the underpinning, the contractor expected to encounter water and to sink the cylinders under the wall by the pneumatic process. When the work was done, however, no water was found, the cylinder went down in the dry, and the underpinning was, therefore, a very simple matter. It showed, however, that the water table had been lowered on account of the tunnel construction about twenty-four feet. The underpinning and maintenance of this wall cost the owner about \$40,000.

"Innumerable cases of foundations weakened by this cause are continually coming to light, and with the demands for higher buildings and greater foundation loads, old foundations must be strengthened, even in the absence of this water level trouble. Modern buildings, especially in New York City, require greater support than can ordinarily be secured by wood piles, depending chiefly on friction for the bearing power, and engineering skill is rapidly solving these new problems by inventions involving both new forms and new methods for foundation work."

The writer then enumerates the preventive methods available for use in guarding against conditions of the nature described. He continues:

"Prevention of the unsatisfactory conditions resulting from the use of wood piles is found in the substitution of concrete or other artificial supports which are unaffected by changes in water level, and which may be made strong enough to carry the loads required.

"Concrete piles have been coming rapidly to the front as combining the necessary elements to most successfully solve this problem. Unaffected by water conditions they may be made of almost any strength desired, and in their many forms of construction and methods of placing are adapted to nearly all conditions of foundation work."

The construction of a big intercepting sewer in Boston lowered the level of constant immersion of the wood piles of numerous buildings. As a result, many of these buildings had to be underpinned at considerable expense. Even in New Orleans, where the city proper is below the level of the Mississippi River, the new deep sewers have so changed the water level as to drain the tops of wood piles placed there. In one particularly notable case, these new sewers lowered the water level sufficiently to expose the wood piles in the foundations of a million dollar building for five feet of their length.

An interesting illustration of the danger of relying upon permanent water levels at an elevation higher than an adjacent large body of water was afforded in connection with the foundation of a large building in St. Louis. This building was designed for concrete piles both in the basement and sub-basement, the latter being twelve to sixteen feet deeper than the former. After making the concrete pile contract, the owner's engineers were seized with a desire to decrease the cost of the work, and made some excavations to determine the elevations at which a permanent water level could be found. The excavations on each side of the basement, probably one hundred and fifty feet apart, indicated water at a certain elevation, which was the same on both sides of the building. A proposition was



Chicago, Rock Island & Pacific Railroad Grain Elevator,
Kansas City, Mo.
McDonald Engineering Company, Contractors



Schorsch & Company Factory, New York, N. Y.
C. B. Comstock, Architect



Goodyear Tire & Rubber Company Building
Long Island City, N. Y.
National Fireproofing Company, Contractors



Loose-Wiles Garage
Long Island City
New York
Wm. Higginson
Architect

then called for to substitute wood piles in the sub-basement, and the piling contract modified to meet this condition. Wood test piles were driven and loaded with satisfactory results, and a supply of wood piles ordered. When the footings were excavated to this level, however, the water found in the test excavations had disappeared and the use of concrete piles was reverted to. It is interesting to note in this connection that in one of the piers in which a wood pile was driven fifty-five feet, the concrete pile core brought up solidly on rock at a depth of twenty-eight feet. It is an equally interesting speculation as to whether the wood pile actually penetrated to a depth of fifty-five feet or whether one of the many disastrous things that can happen to a wood pile actually occurred in this case; for instance, note the photographs at the bottom of this page.

In some cases, in order to overcome the drainage of the soil, sprinkler systems have been installed to keep wood piles saturated. Such an arrangement is, of course, only a makeshift. A more permanent method is required to guard against the settlement, if not collapse, of the buildings supported by the impaired wood piling.

Many buildings along the water fronts of our large cities are erected on wood piles driven in soil, saturation of which is dependent upon the flow of the tides. The filling-in of land between such buildings and the body of water near which they are located has, in many cases, worked havoc with the wood piles by cutting them off from their source of saturation — the tides. The drainage of Lake Texcoco, near Mexico City, has brought about a corresponding lowering of the water level in the city. The result has been the settlement of a large number of structures supported by wood pile foundations. The construction of deep foundations alongside of more shallow ones, and the diversion of springs encountered in excavations for various purposes, are additional dangers that threaten, through soil drainage, the integrity of wood pile foundations. The dropping of the assumed water level is a local condition that may make wood piling dear

at any price, and even if there were no other advantages, would give the preference to concrete piling.



Examples of
Over-Driven Wood Piles





Keith Theatre Building, Cleveland, Ohio.
Rapp & Rapp, Architects.



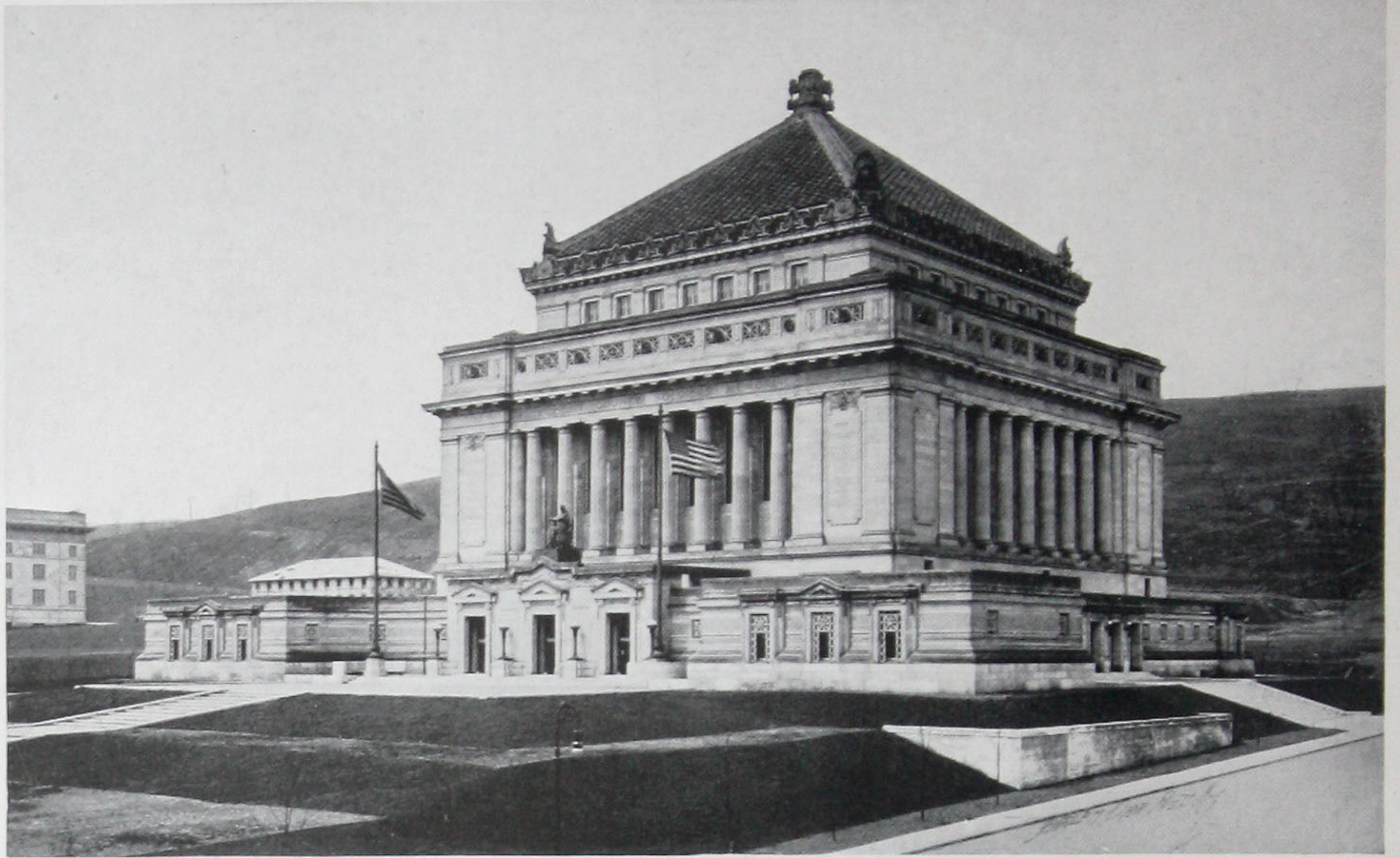
Hallenbeck-Hungerford Building, White and Lafayette Sts., New York, N. Y.
Wm. E. Austin, Architect



A group of buildings in the "Streeterville" district of Chicago, all of those completely shown resting on Standard Raymond Concrete Piles.



Forty-two Story L. C. Smith Building, Seattle Wash.
Gaggin & Gaggin, Architects 1200 Raymond Concrete Piles



Soldiers' Memorial, Pittsburgh, Pa. Palmer, Hornbostle & Jones, Architects
193 Raymond Concrete Piles



Hartman Furniture and Carpet Company Warehouse, Chicago, Ill.
Ottenheimer, Stern & Reichert, Architects 739 Raymond Concrete Piles

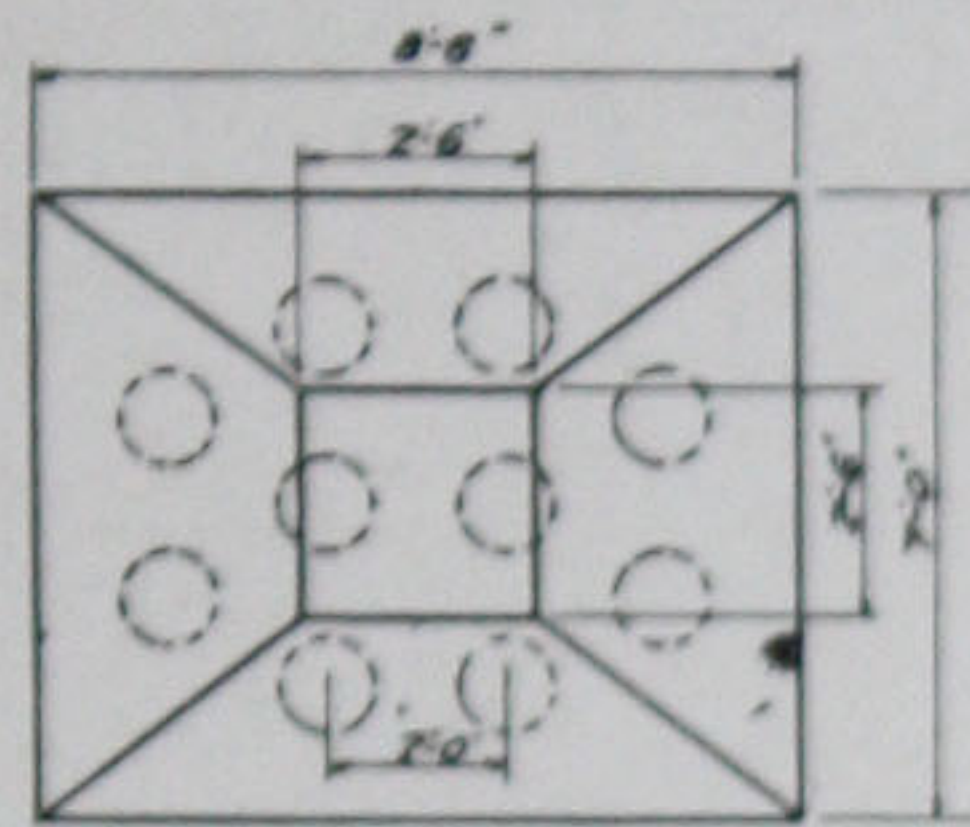


Armstrong Cork Company Building, Pittsburgh, Pa.
Henry Boettsche, Engineer
615 Raymond Concrete Piles

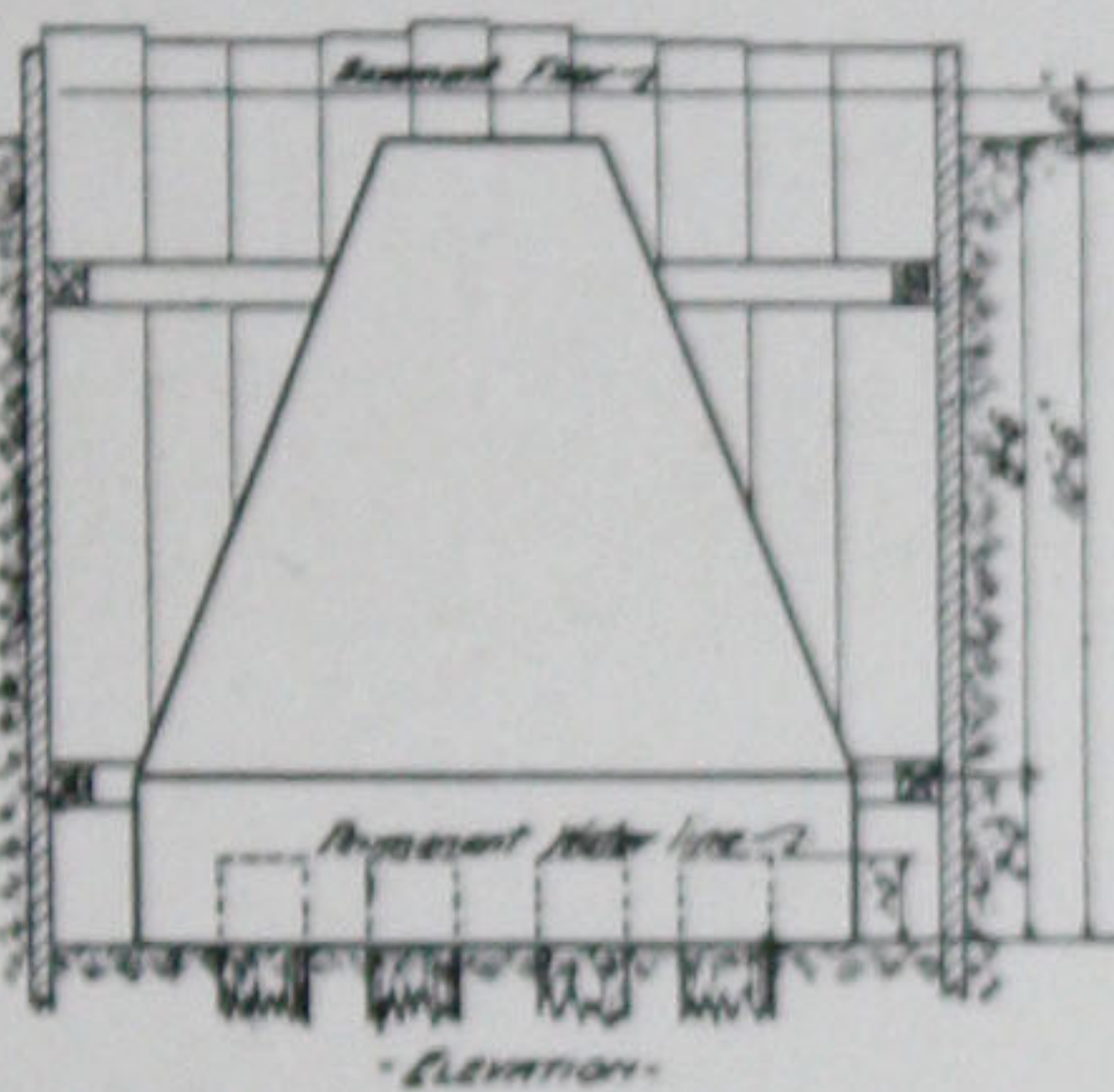
Wood Piles vs. Concrete Piles

Typical Footings showing Comparative Quantities Required in Each Case

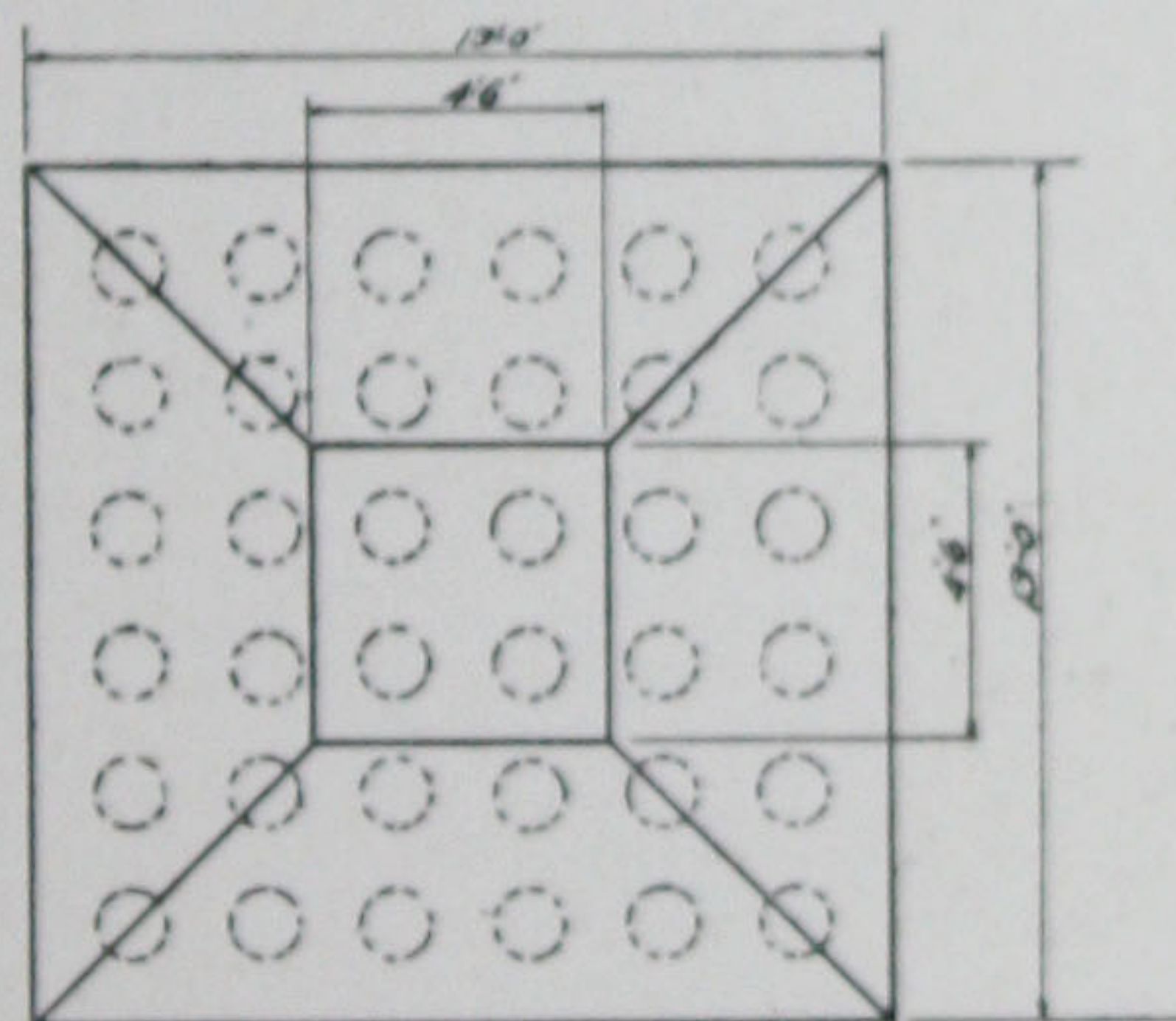
- WOOD PILE LAYOUT -



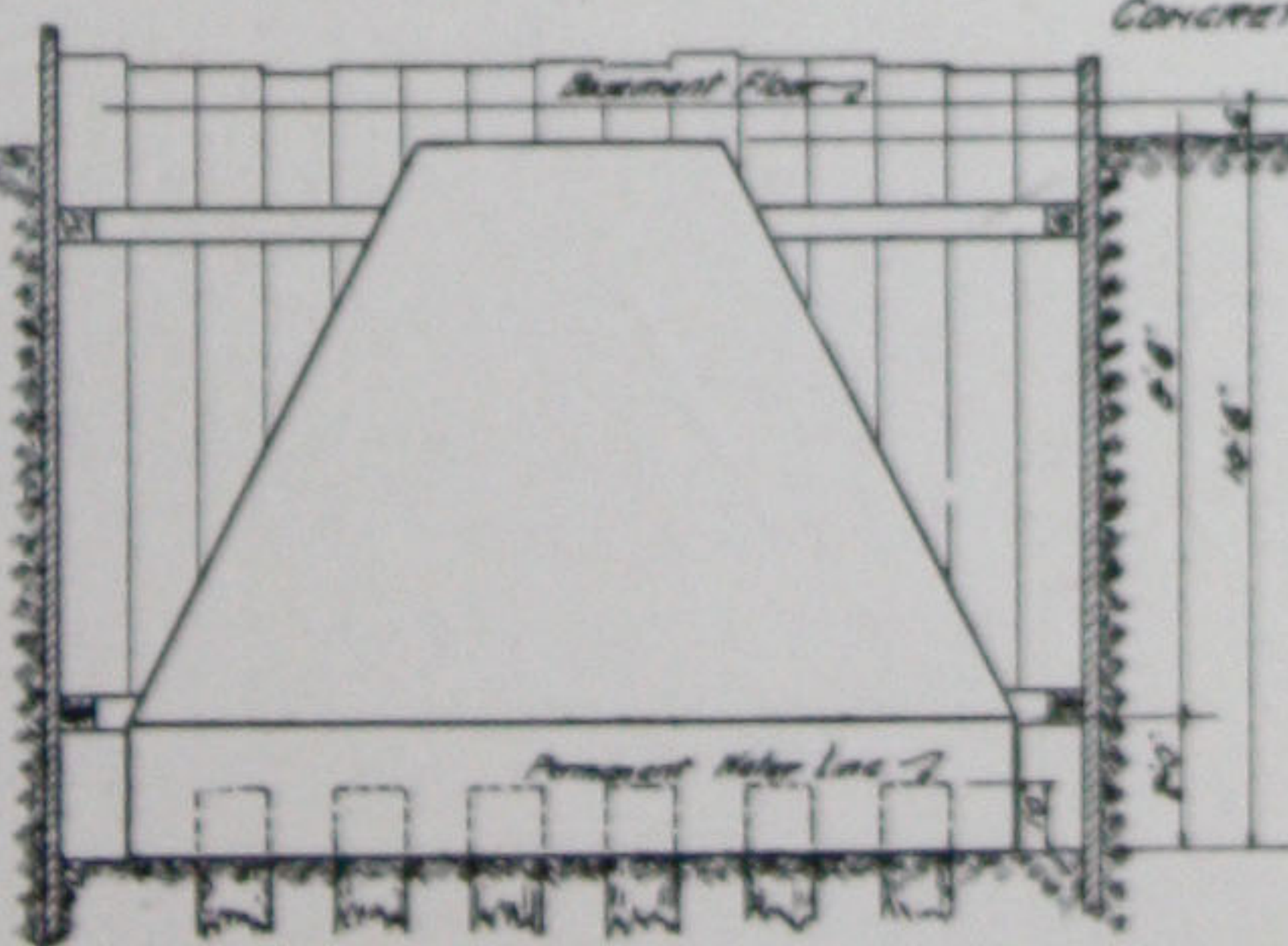
- PLAN -



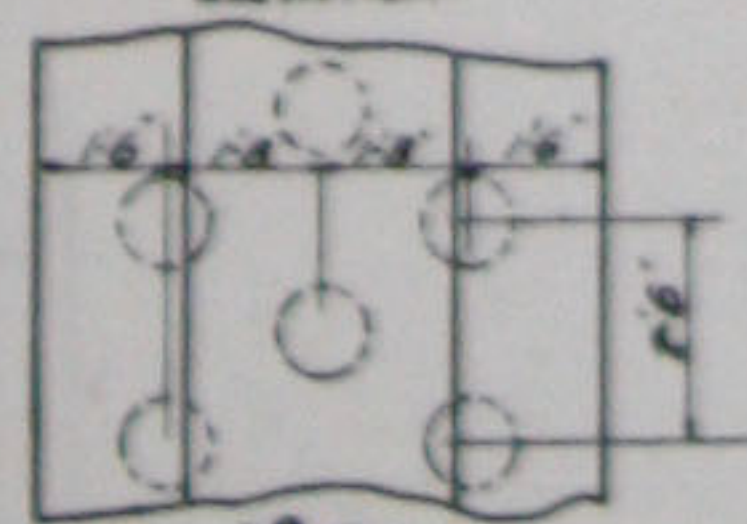
- ELEVATION -



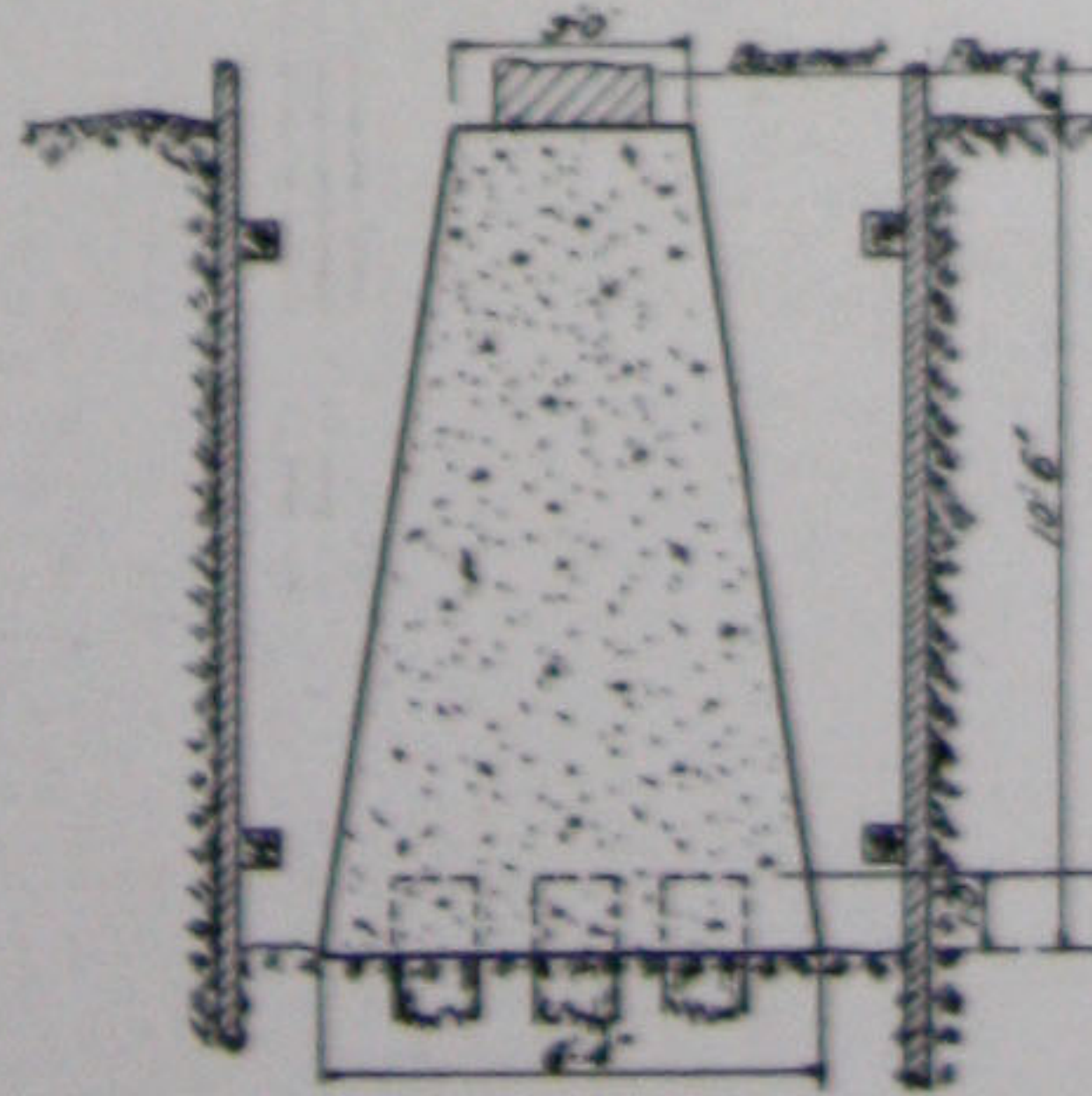
- PLAN -



- ELEVATION -

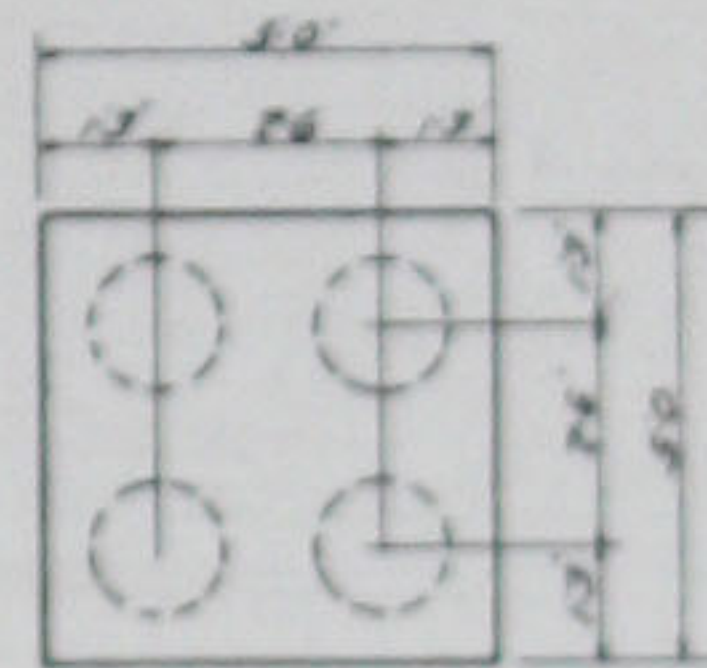


- PLAN -

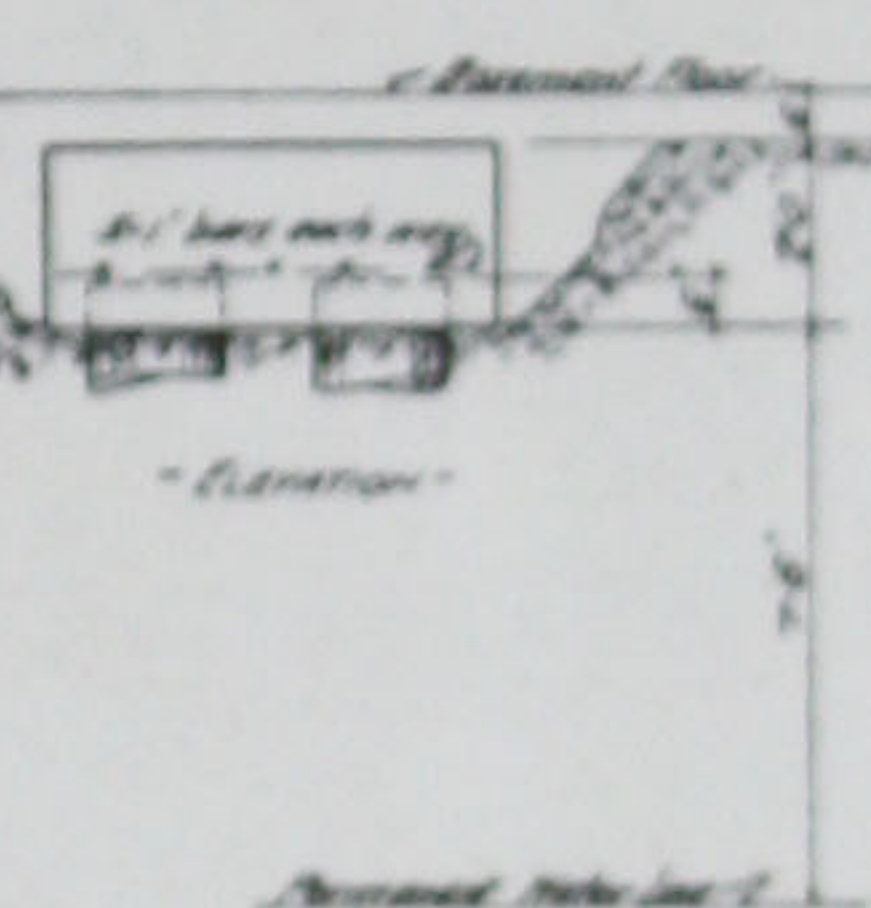


- ELEVATION -

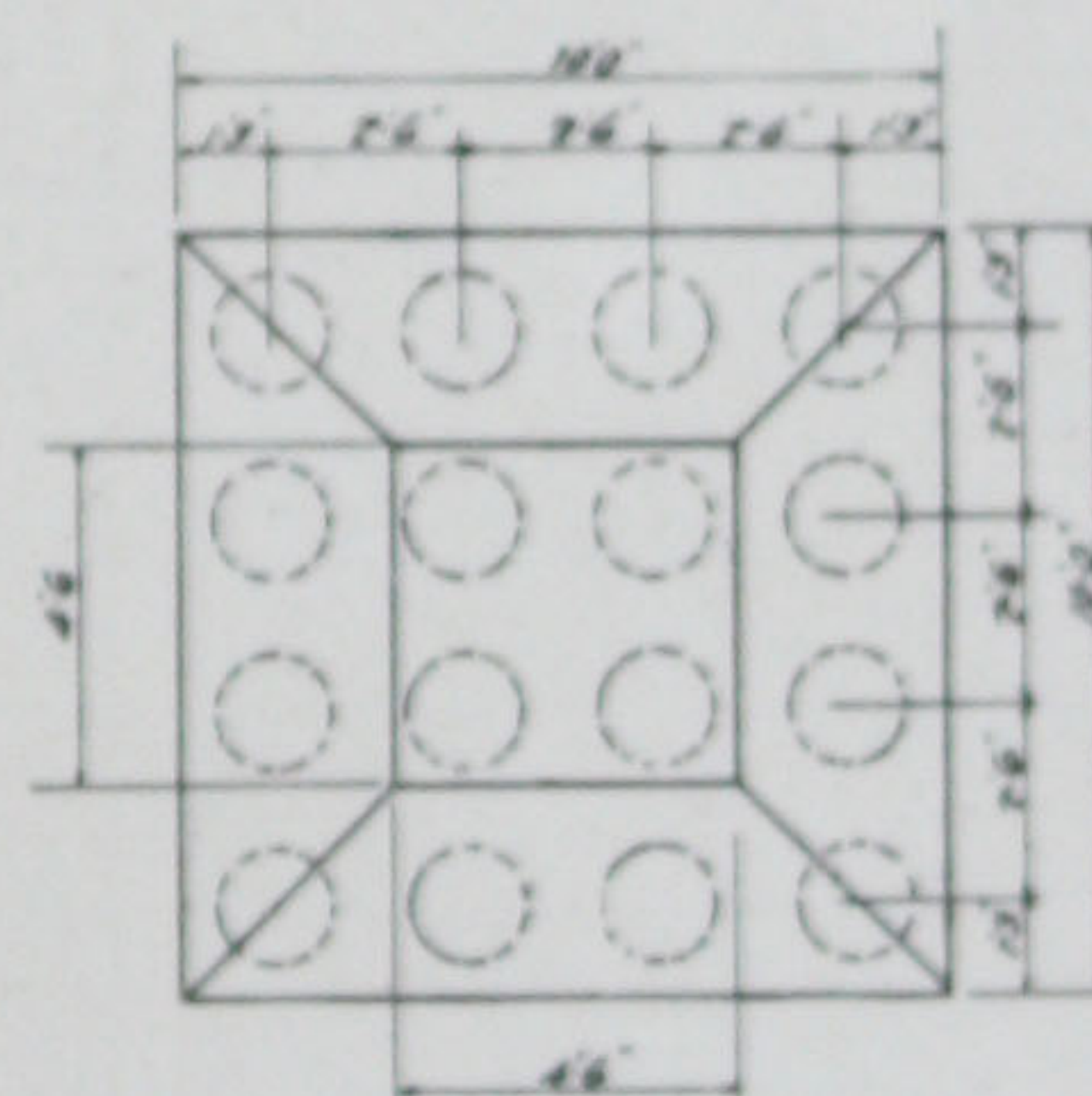
- CONCRETE PILE LAYOUT -



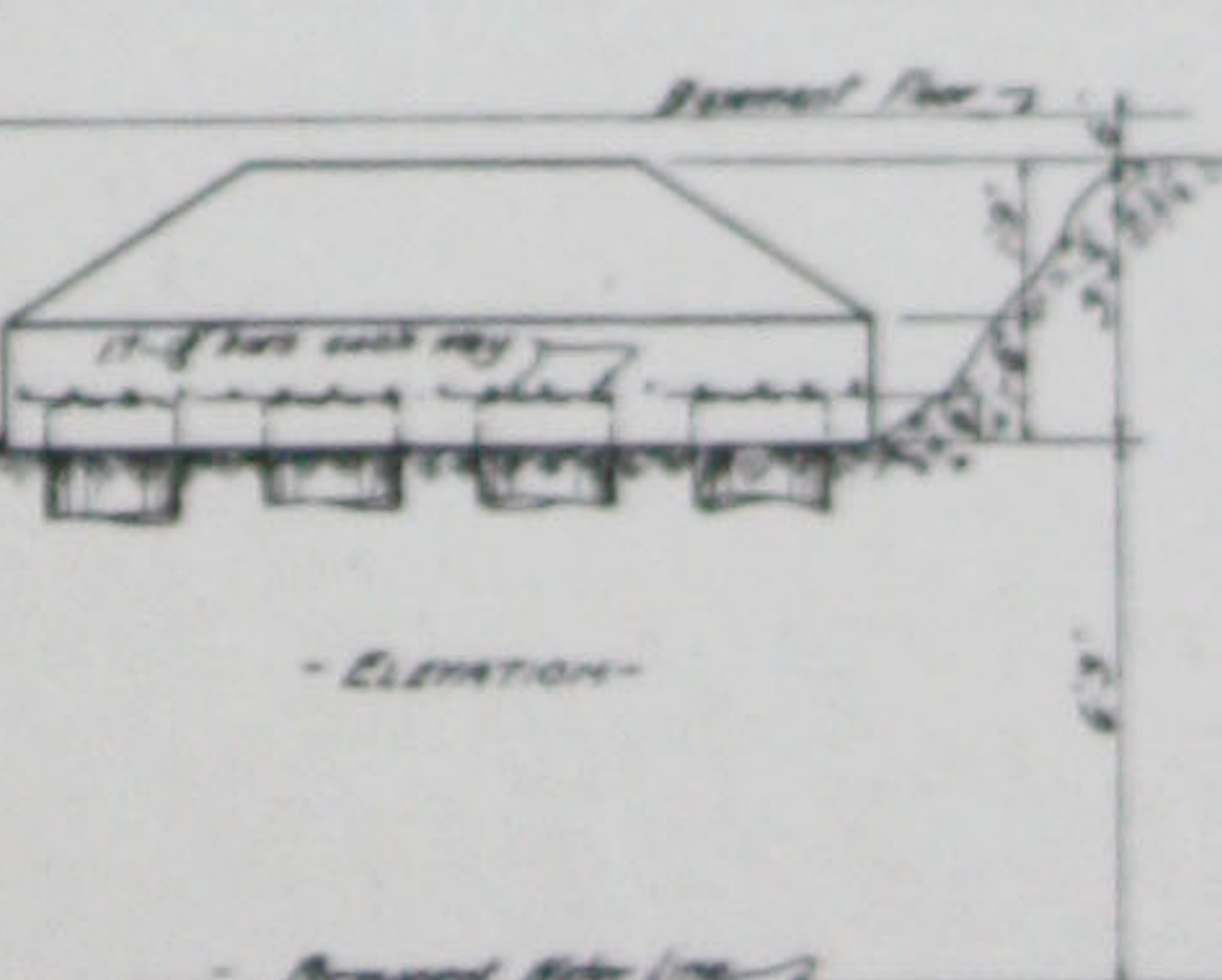
- PLAN -



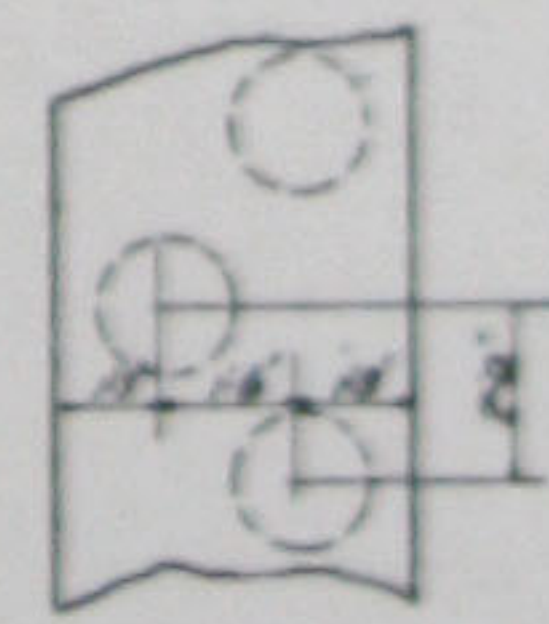
- ELEVATION -



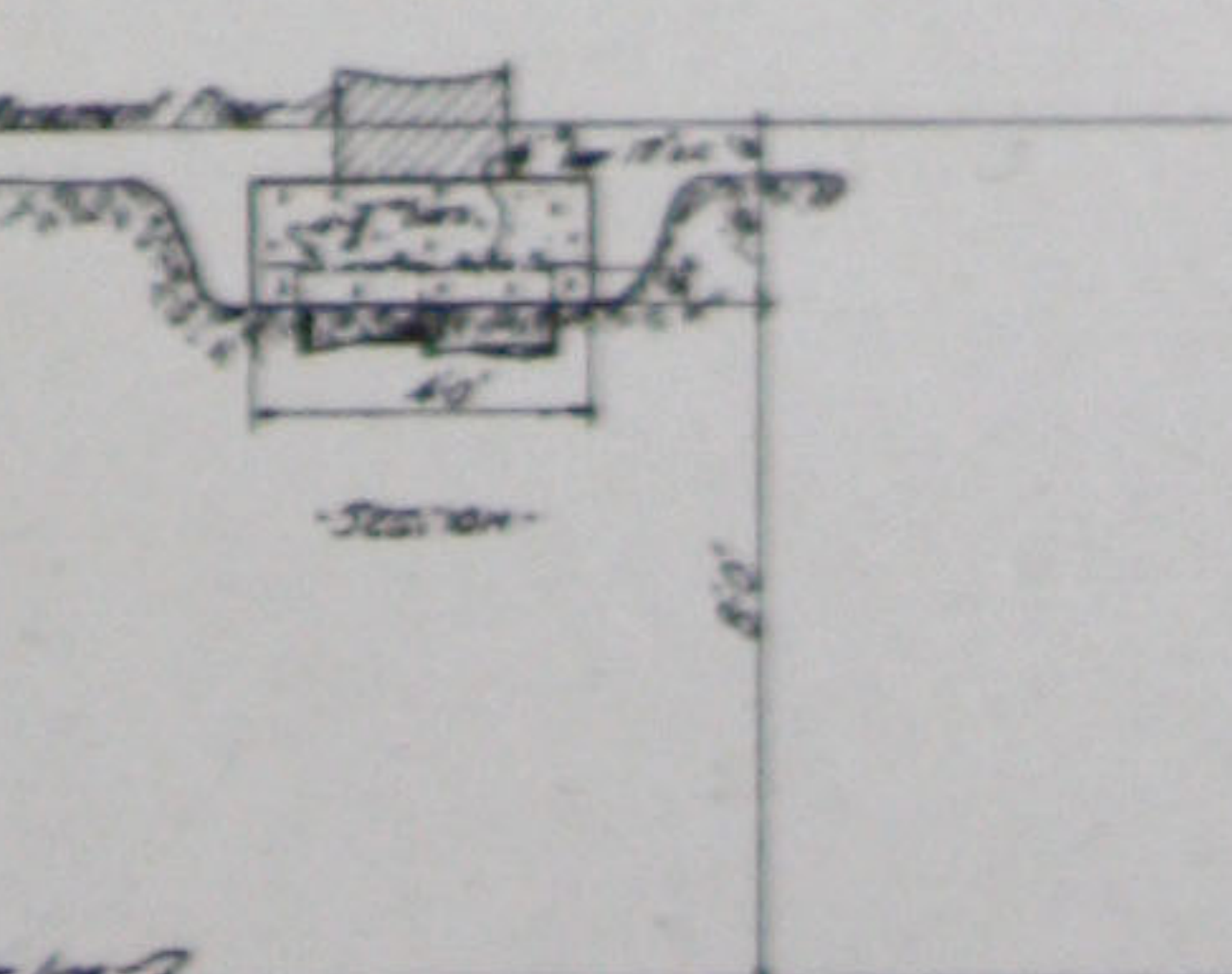
- PLAN -



- ELEVATION -



- PLAN -



- SECTION -

- QUANTITIES -

WOOD PILES - 10
CONCRETE - 13 cu Yds.
STEEL - 0
FORMS - 237 Sq Ft.
EXCAVATION - 36 cu Yds.
SHEETING - 39 LWP 12'0" Deep

COLUMN LOAD - 116 TONS
WOOD PILE LOAD - 15 TONS
CONCRETE PILE LOAD - 30 TONS

- QUANTITIES -

CONCRETE PILES - 4
CONCRETE - 1.85 cu Yds.
STEEL - 153 LWP
FORMS - 40 Sq Ft.
EXCAVATION - 3.63 cu Yds.
SHEETING - 0

- QUANTITIES -

WOOD PILES - 36
CONCRETE - 38.5 cu Yds.
STEEL - 0
FORMS - 419 Sq Ft.
EXCAVATION - 87.5 cu Yds.
SHEETING - 60 LWP 12'0" Deep

COLUMN LOAD - 461 TONS
WOOD PILE LOAD - 15 TONS
CONCRETE PILE LOAD - 30 TONS

- QUANTITIES -

CONCRETE PILES - 16
CONCRETE - 9.1 cu Yds.
STEEL - 1390 LWP
FORMS - 156 Sq Ft.
EXCAVATION - 13.4 cu Yds.
SHEETING - 0

- QUANTITIES PER FOOT -

WOOD PILES - 12
CONCRETE - 1.91 cu Yds.
STEEL - 0
FORMS - 21 Sq Ft.
EXCAVATION - 3.25 cu Yds.
SHEETING - 2 LWP 12'0" Deep

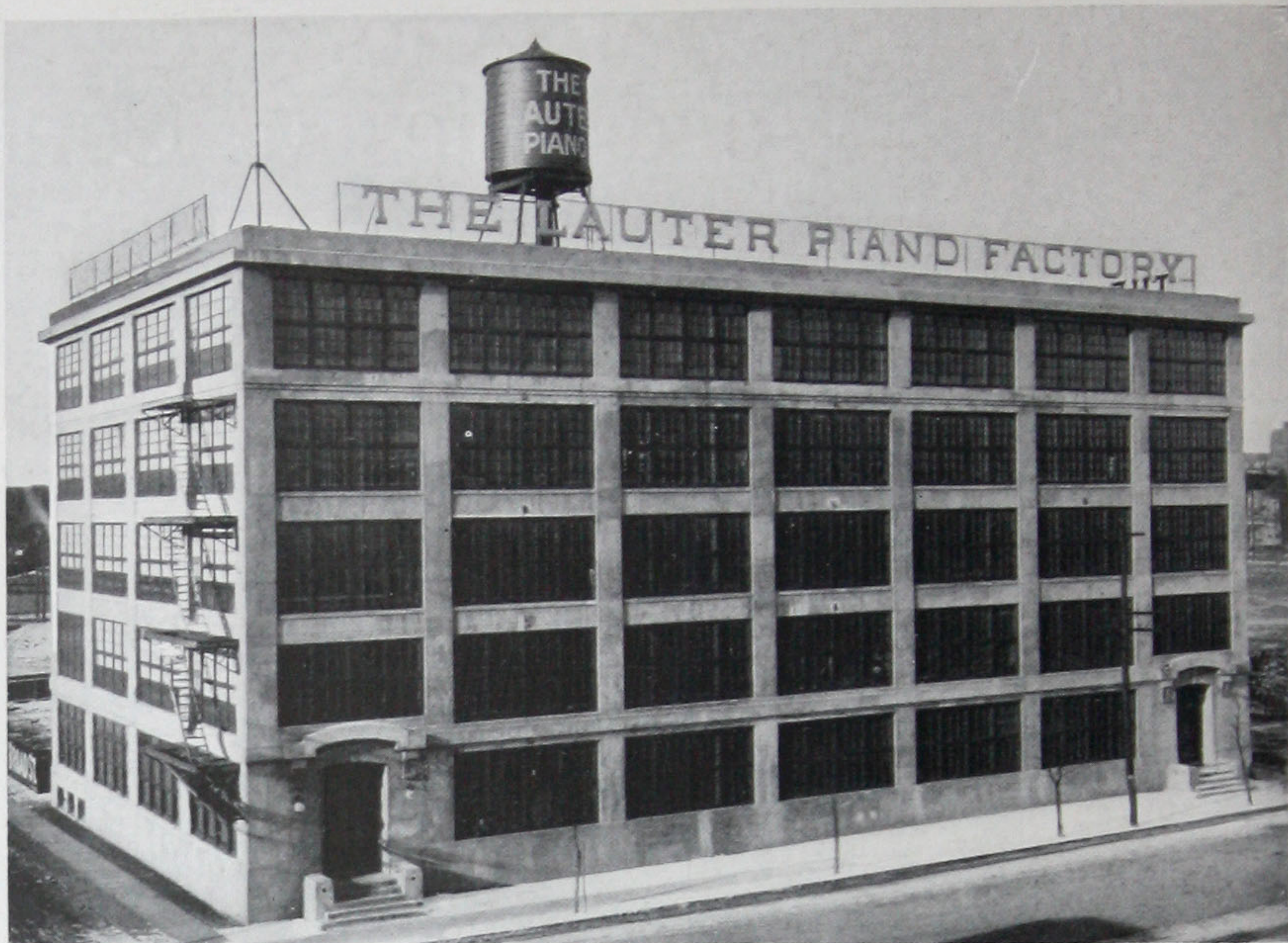
WALL LOAD PER FOOT - 15 TONS
WOOD PILE LOAD - 15 TONS
CONCRETE PILE LOAD - 30 TONS

- QUANTITIES PER FOOT -

CONCRETE PILES -
CONCRETE - .775 cu Yds.
STEEL - 13.6 LWP
FORMS - 3 Sq Ft.
EXCAVATION - .33 cu Yds.
SHEETING - 0



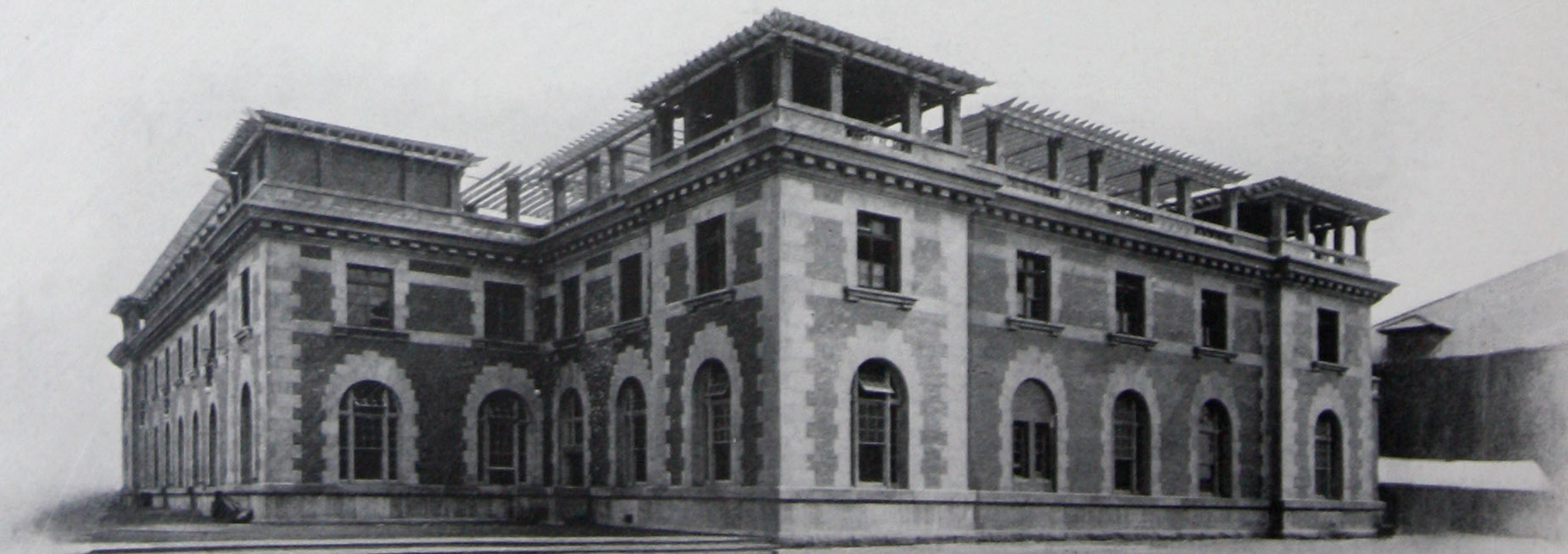
Buffalo General Electric Company Building
Buffalo, N. Y.
Esenwein & Johnson, Architects
262 Raymond Concrete Piles



Lauter Piano Factory, Newark, N. J. American Concrete Steel Company, Engineers
308 Raymond Concrete Piles

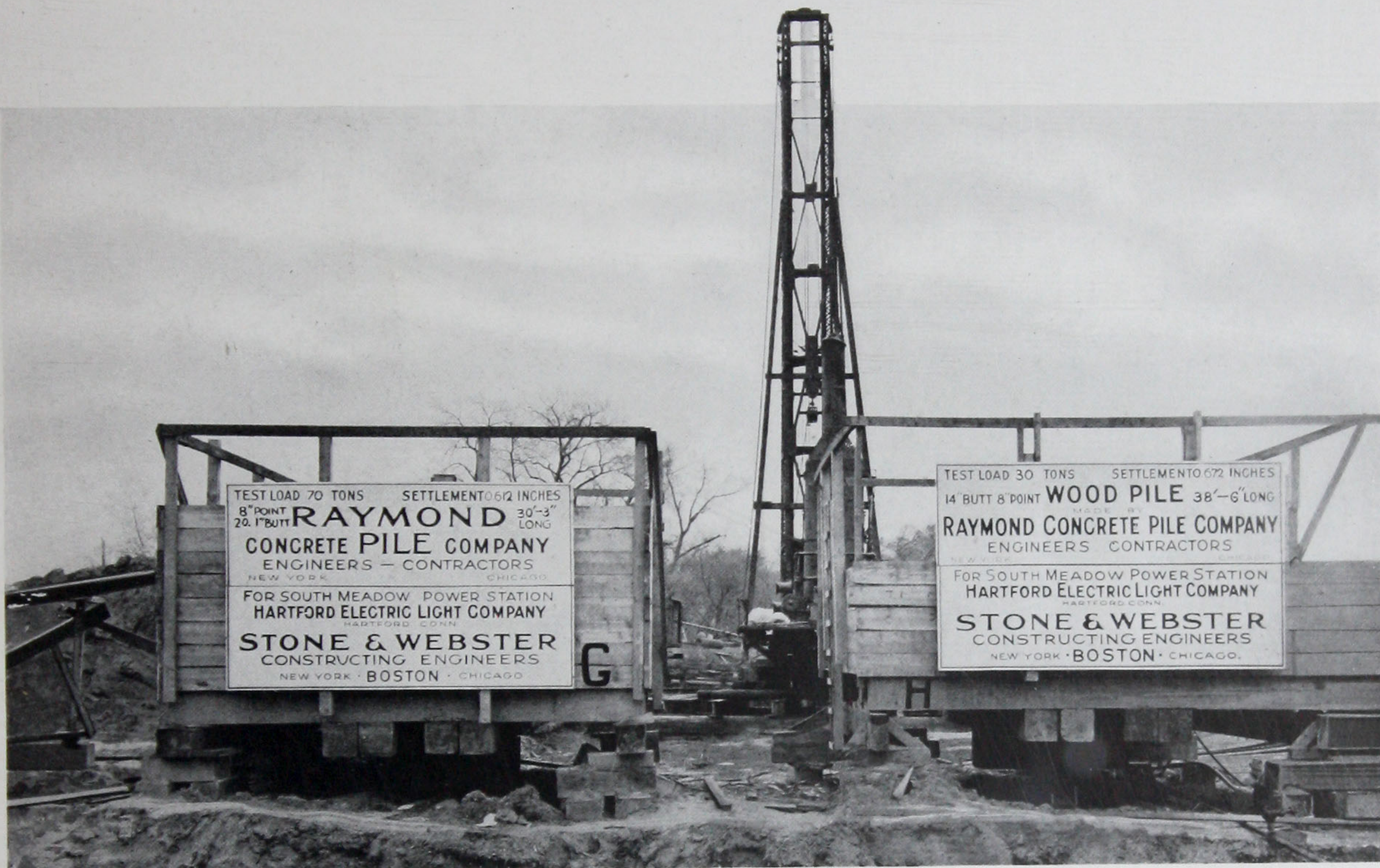


Crerar Adams Warehouse, Chicago, Ill.
Ottenheimer, Stern & Reichert, Architects
499 Raymond Concrete Piles

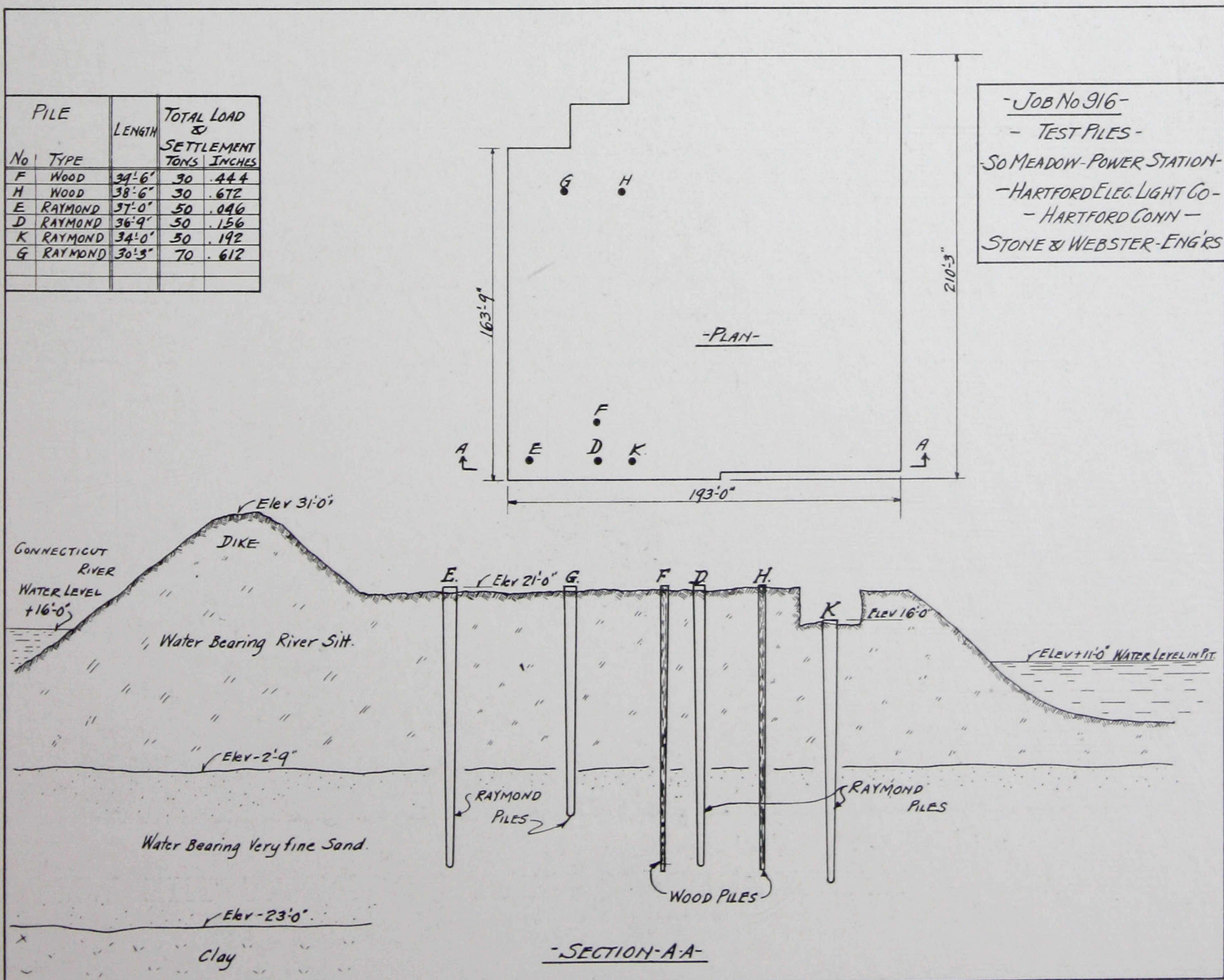


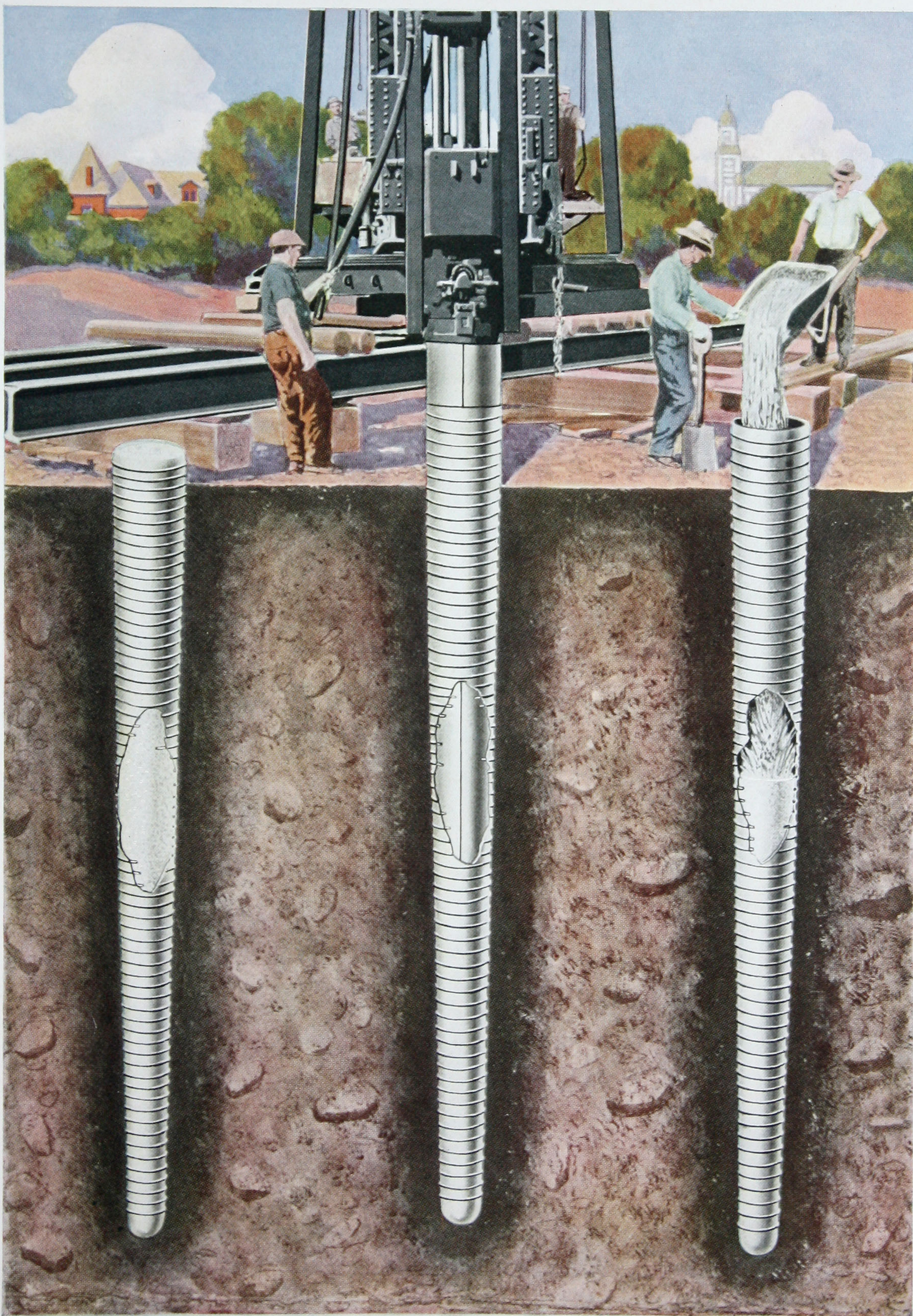
Baggage Dormitory, Ellis Island, New York. James Knox Taylor, Architect
233 Raymond Concrete Piles

Concrete Piles vs. Wood Piles

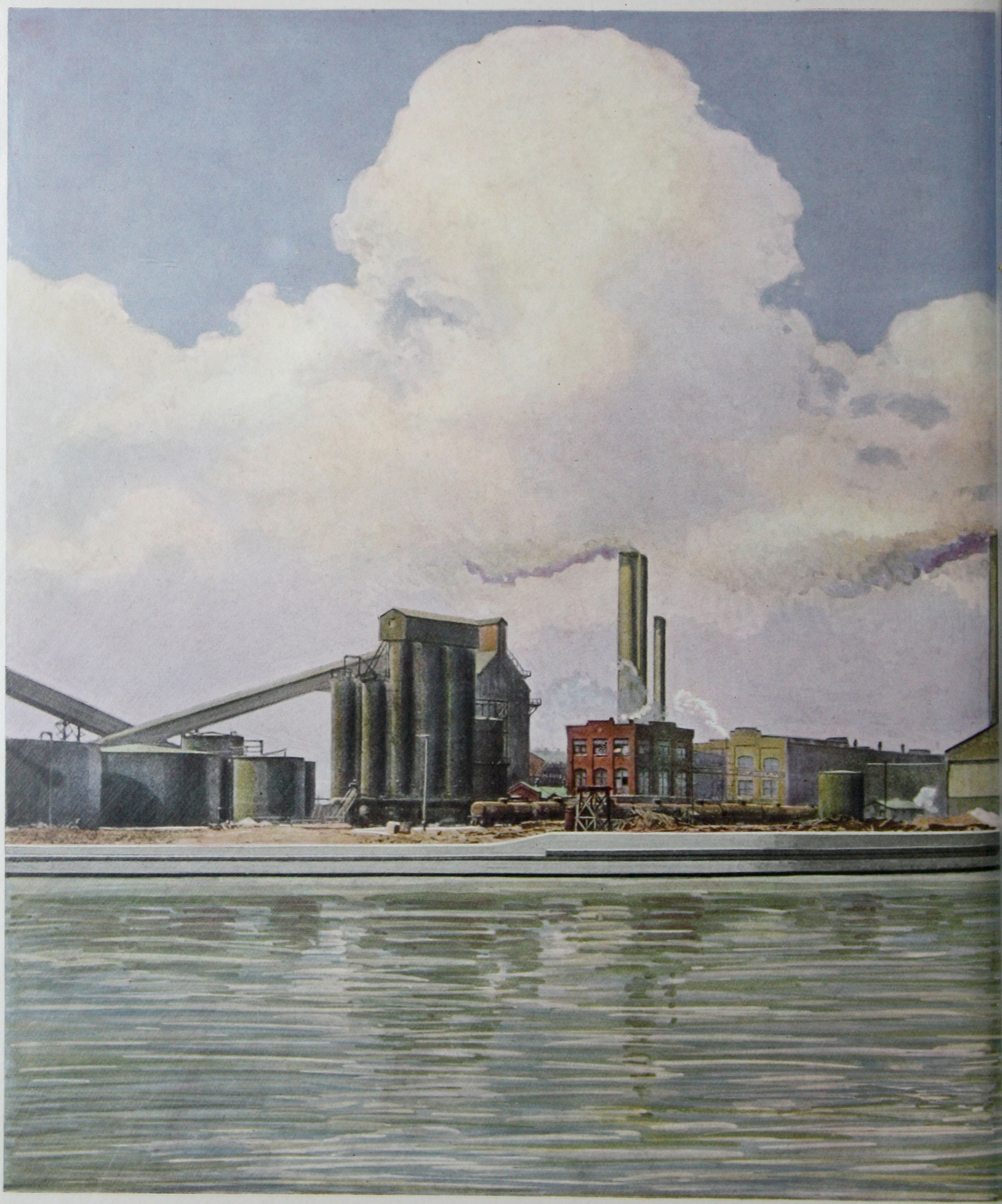


Comparative Test of Wood and Concrete Piles. Test made by Stone & Webster, Engineers
Hartford Electric Light Company, Meadow Power Station, Hartford, Conn., F. D. Knight, Supt., Stone & Webster Co.





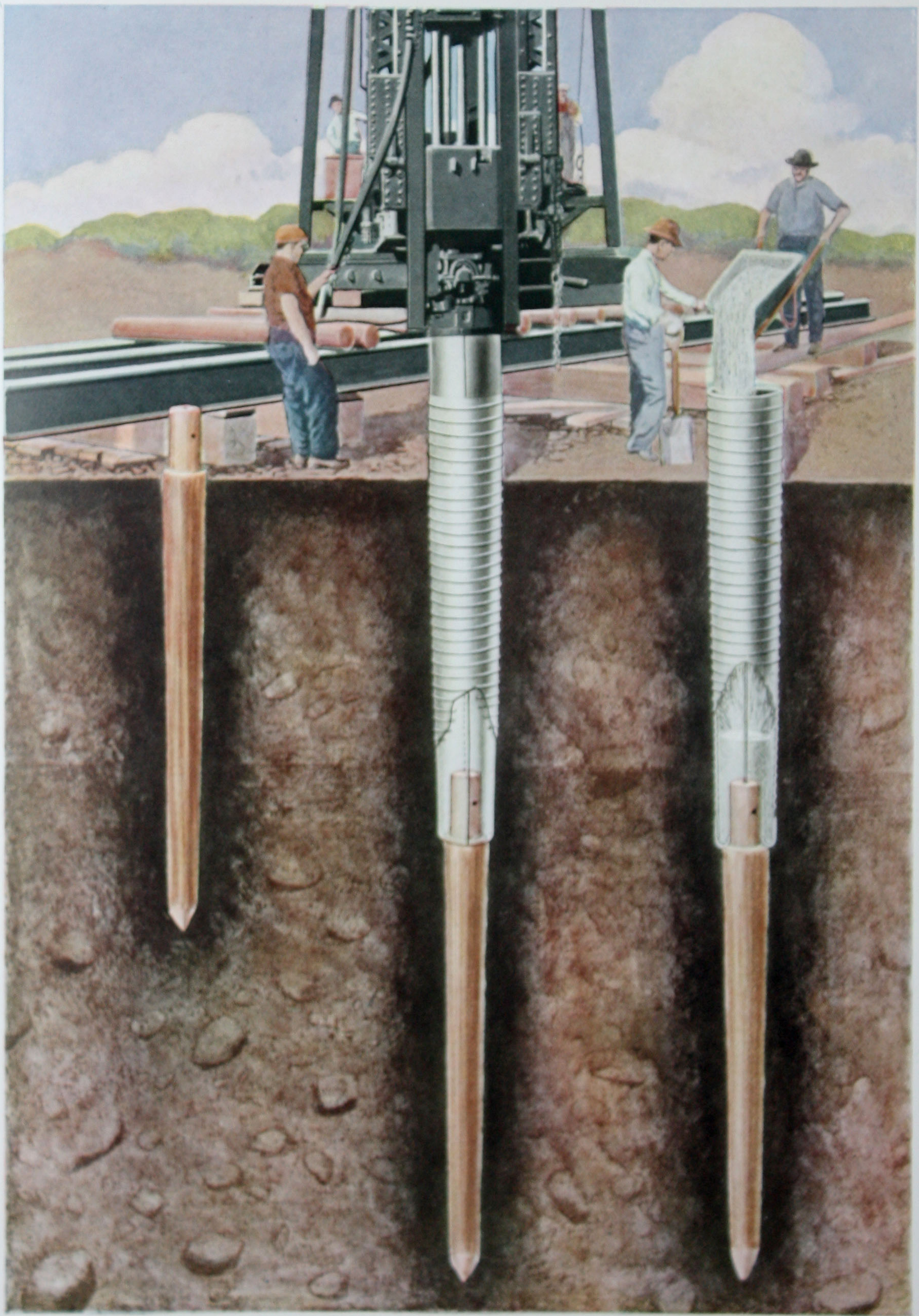
STANDARD RAYMOND CONCRETE PILES



REINFORCED CONCRETE DOCK AT THE WISCONSIN STEEL WORKS
CALUMET RIVER -



PLANT OF THE INTERNATIONAL HARVESTER COMPANY
CHICAGO, ILLINOIS

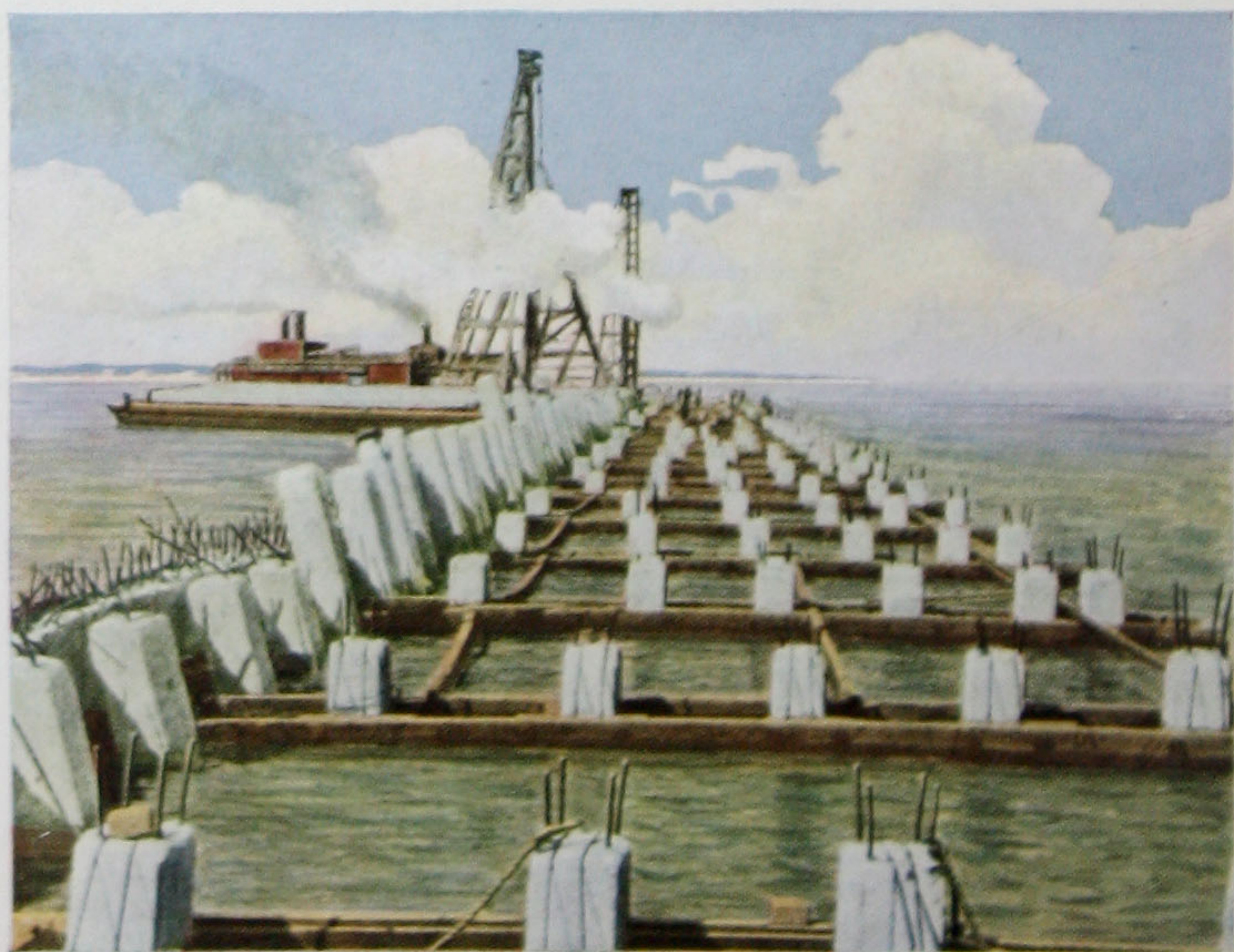


RAYMOND COMPOSITE PILES



ABOVE—Reinforced Concrete Piles for Havana Docks, Havana Docks Corporation, Havana, Cuba.

RIGHT—Precast Concrete Piles for Municipal Grain Elevator Piers, Norfolk, Virginia.



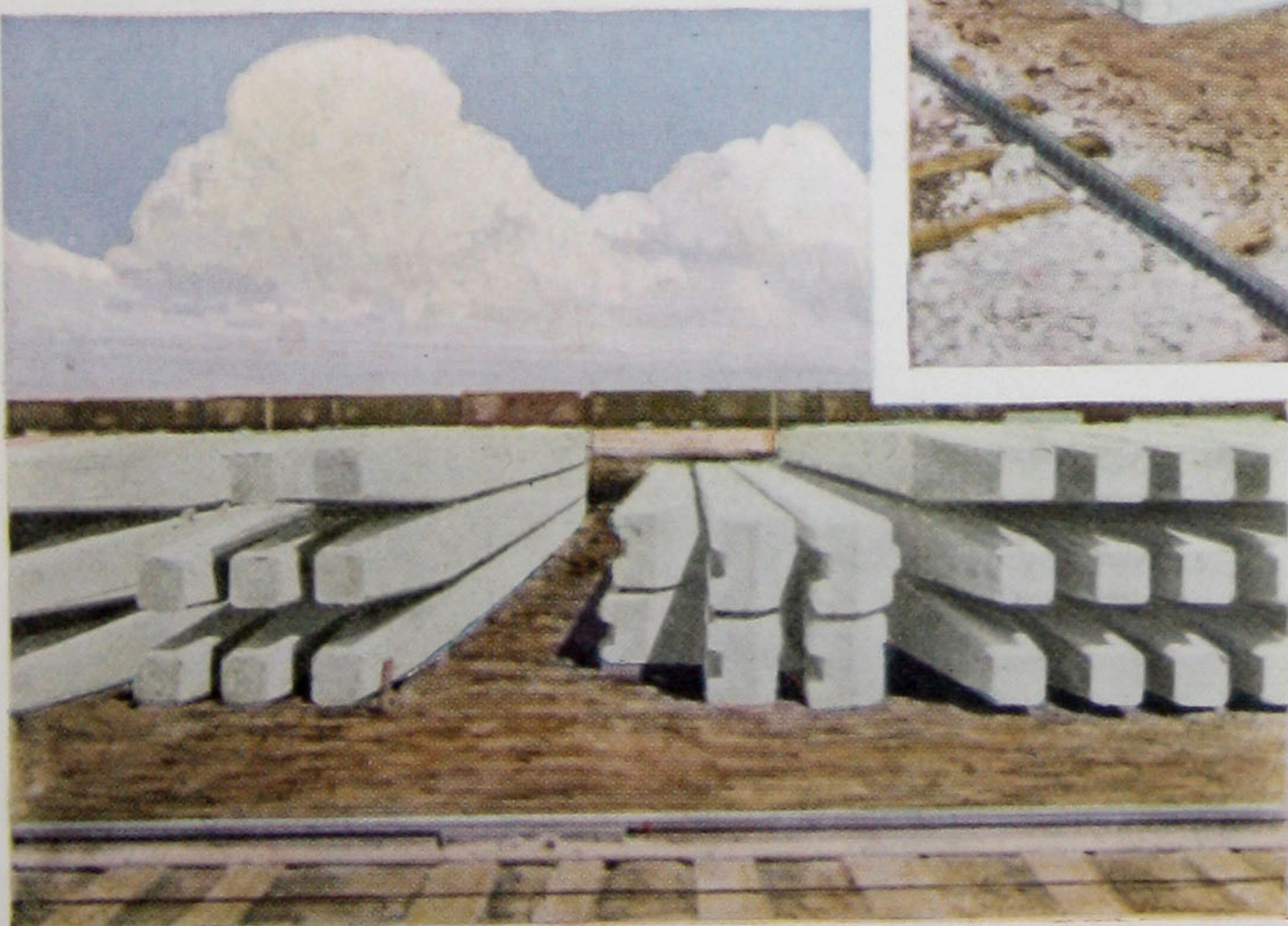
Precast Piles and Reinforced Concrete Dock for Bureau of Yards and Docks, Charleston, South Carolina.



Concrete Highway Trestle across
Santee River, South Carolina.



ABOVE—Precast Concrete Piles
for Havana Docks, Havana
Docks Corporation, Havana,
Cuba.



LEFT—Precast Concrete Sheet
Piles and Bearing Piles for Muni-
cipal Grain Elevator Piers, Nor-
folk, Virginia.

Raymond Piles in Reclaimed Land

IN the growth and development of cities, the high ground where firm soil is found is usually built upon first, but it becomes desirable and even necessary to extend operations to low ground which has been filled, and even to swamp and marsh land. In the vicinity of New York City, for example, development is taking place on the Jersey and Long Island meadows and swamp land. It is being drained and filled to desirable levels and the question of foundations seems a serious one until the use of concrete piles is considered.

A number of large structures have recently been built on Raymond Concrete Piles in the low land of Long Island with conspicuous economy; and others are in contemplation. In a great many places, filled ground in which Raymond Piles have been driven, is utilized for the construction of large industrial plants.



Raymond Piles vs. Open Caissons

WHERE rock can be reached at reasonable depth and without the difficulties caused by excessive water or quicksand and the loads are very heavy, open caisson foundations are economical as well as efficient.

If, however, rock is fifteen feet or more below the bottom of the basement floor, a comparison with concrete piles from the standpoint of cost and time saving is always worth while.

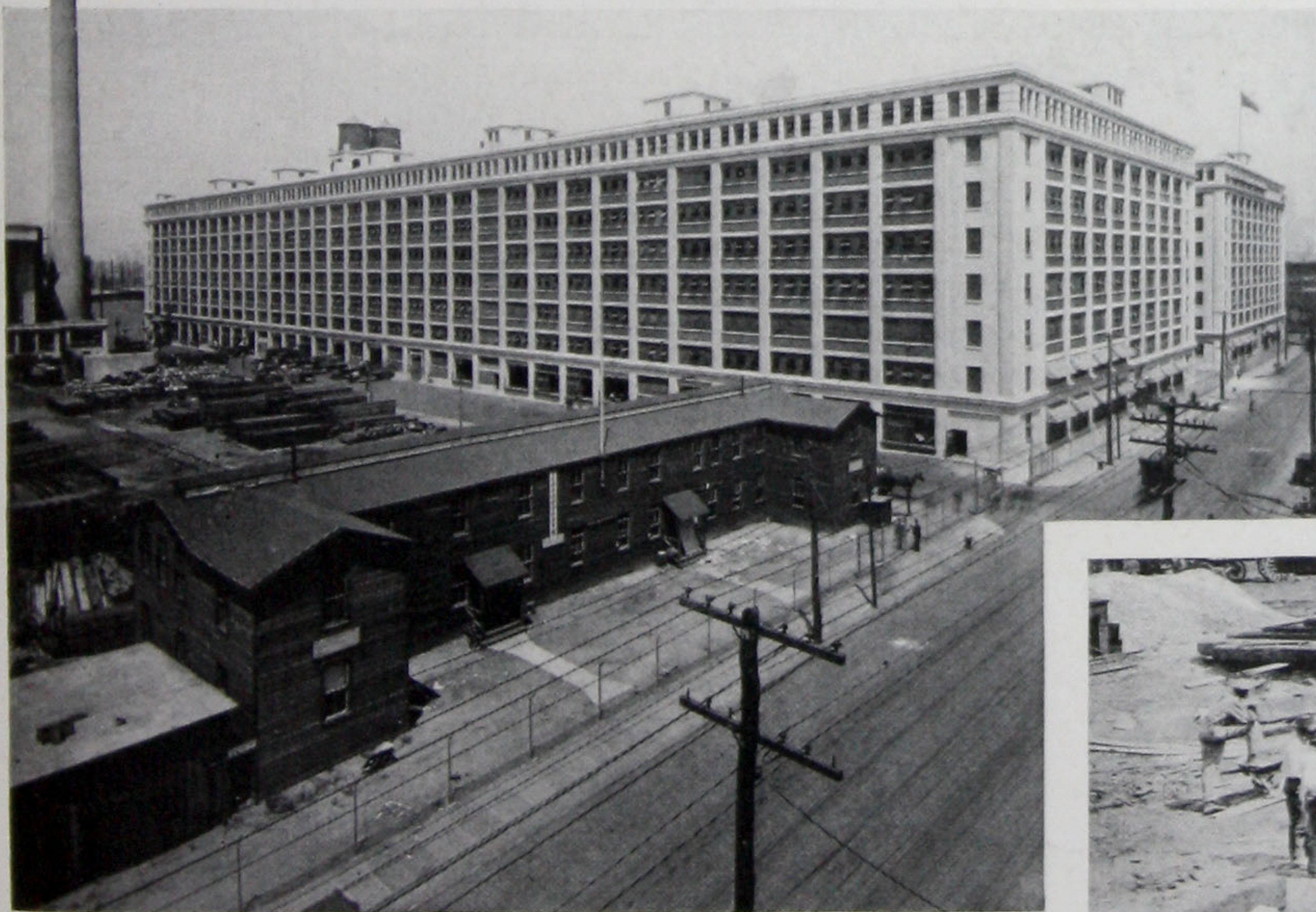


Afton Development Company
Stack, Afton, N. Y.

25 Raymond Concrete Piles



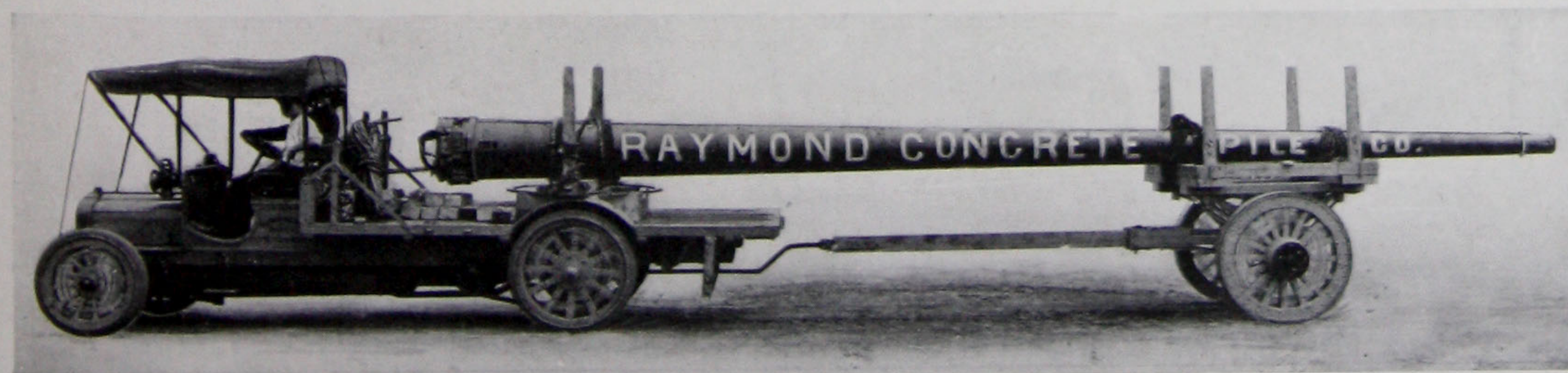
Winter weather has no terrors for the Raymond organization



Naval Supply Base, South Brooklyn, Turner Construction Co.,
General Contractors. Lt. S. Schroeder in charge
12253 Raymond Concrete Piles



Raymond Piles may be placed on
any reasonable batter



Emergency service, where speed is essential

Raymond Concrete Piles *vs.* Mat Foundations

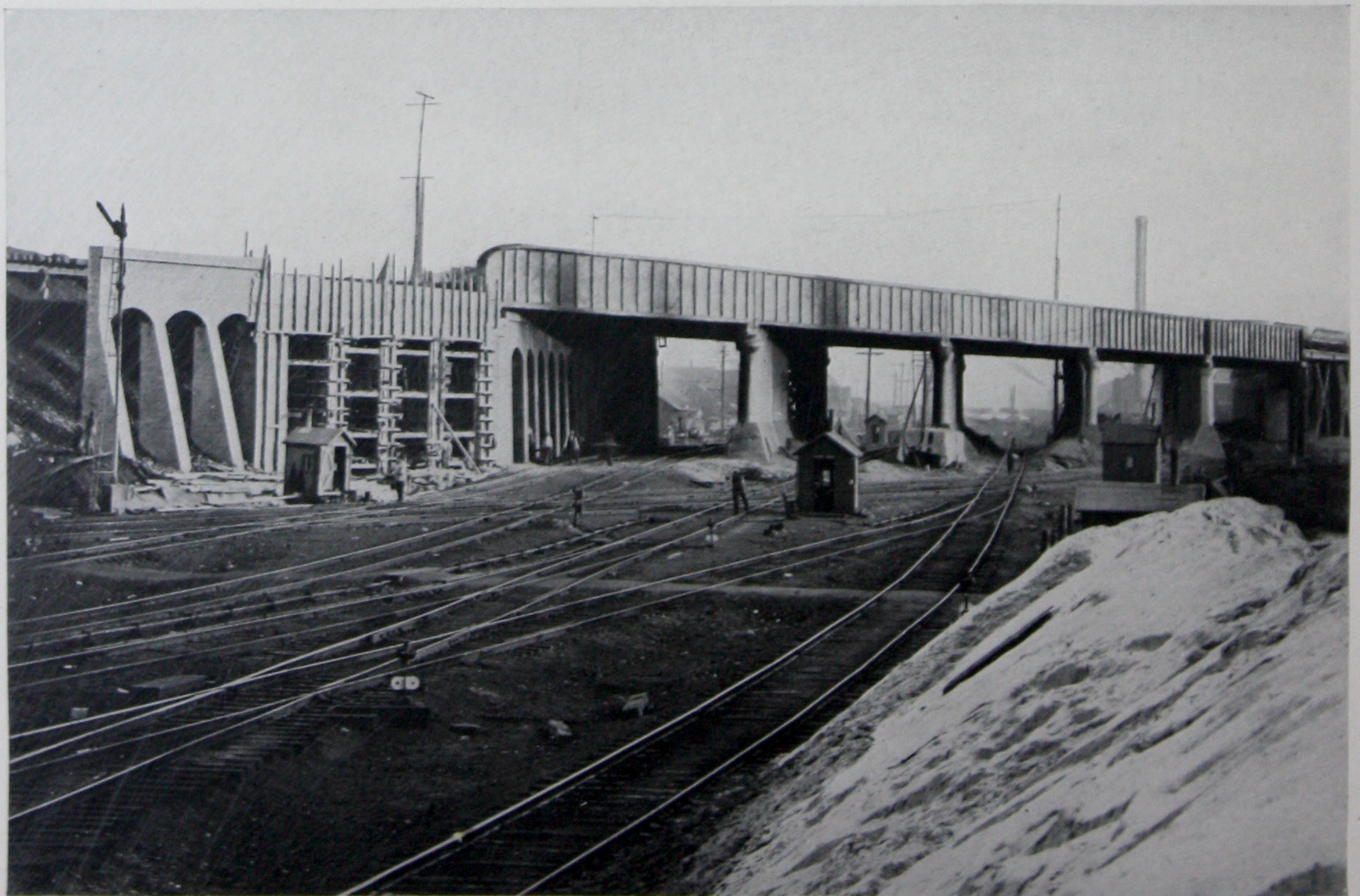
WHERE conditions seem to warrant consideration of a concrete mat or raft foundation, it is reasonable to assume that the soil is of low bearing value.

If the loads to be carried are heavy, Raymond Piles can usually be secured at a lower cost and their efficiency is beyond question. Every soft spot is found when driving the spirally reinforced steel shell in which each Raymond Pile is cast and a sufficient length of pile is developed to carry the designed load. Thus every pile is efficient for its full load and there is no danger of overloading at any point.

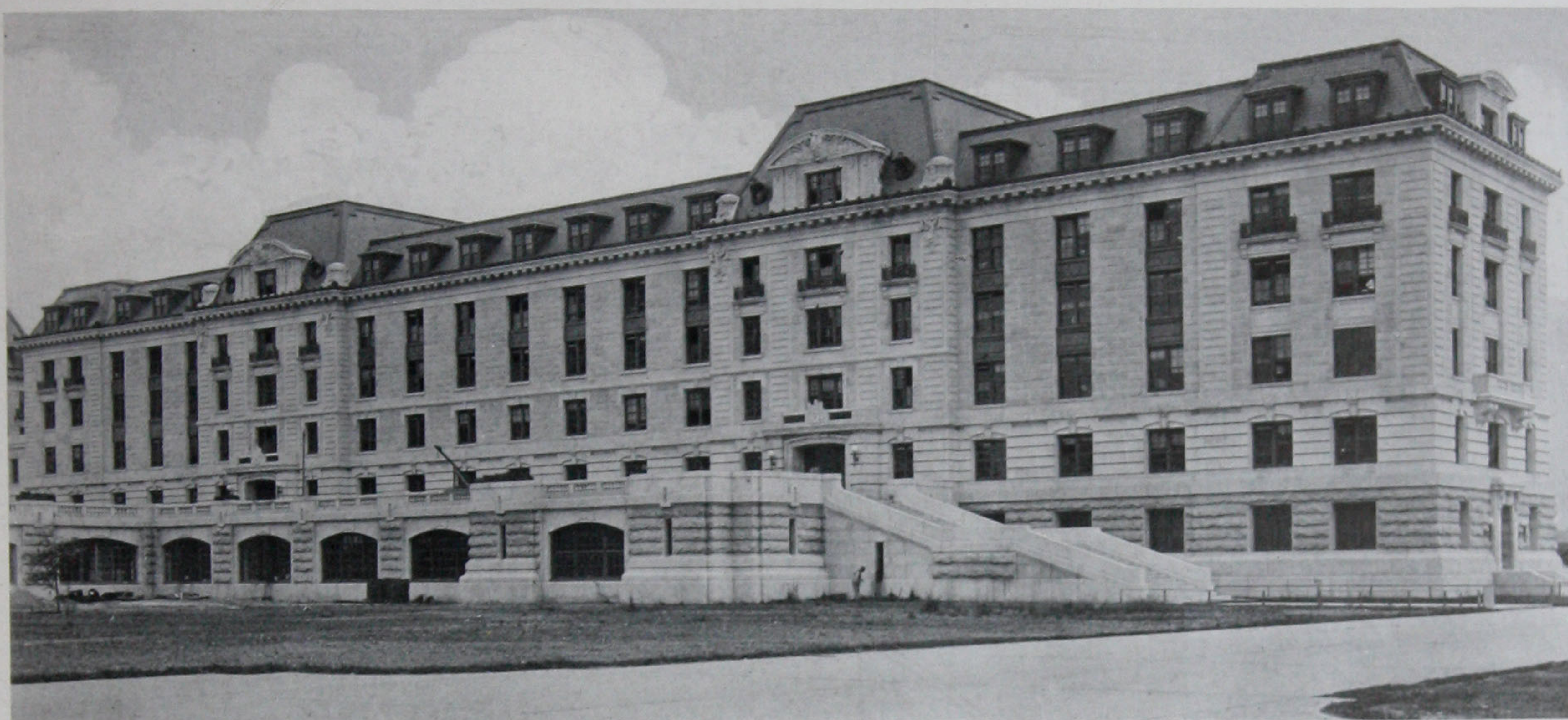
Due to lack of uniformity of the soil a mat foundation has a tendency to settle out of plumb. Even in soils which are approximately uniform there is always danger of uneven settlement of a mat foundation unless the structure itself is not only perfectly symmetrical, but is symmetrically loaded. This is especially noticeable in the City of Mexico, where such conditions are apparent to the most casual observer. It is frequently the case that portions of a building have comparatively little live load at some periods, while other portions during the same time are loaded to capacity. Furthermore, there is always danger of a mat foundation being undermined by the construction of adjacent foundations.

RAYMOND CONCRETE PILES *vs.* SPREAD FOOTINGS

IT has been found in a great many instances where the soil is considered of fair bearing value, and where heavy loads are to be sustained that Raymond Concrete Piles offer a means of securing a superior foundation at a minimum cost. By driving the spirally reinforced steel shells the soil is made more compact and is given greater bearing value. Soil values are thus equalized and the shrinkage taken care of before the building loads are applied.



Chicago, Rock Island and Pacific Railway. Track Elevation Work, Chicago, Ill.
C. A. Morse, Chief Engineer; Robert Ford, Engineer Track Elevation
13,000 Raymond Concrete Piles used



U. S. Naval Academy Building, Annapolis, Md. Ernest Flagg, Architect

An Illustration of the Initial Economy of Raymond Piles

U. S. Naval Academy, Annapolis

A CASE illustrating the initial economy of Raymond Piles is offered by the foundations of the academic group of buildings at the United States Naval Academy, Annapolis.*

Certain portions of the \$10,000,000 appropriation made by Congress for rebuilding the Naval Academy were allotted to the various buildings. When the bids for the academic group were opened, the lowest, that of John Pierce, of New York, was found far to exceed the \$1,500,000 allotted for the group, and some method had to be resorted to which would reduce the cost and still preserve the general plan of the buildings. Raymond Piles were suggested, and upon investigating it was found that by substituting them for the wood piles shown in the original plans the cost would be reduced by about \$27,000.

The following reductions in the foundations of the two buildings were effected through the use of Raymond Piles: 2193 wood piles were replaced by 855 Raymond Piles; 4542 yards of excavation were reduced to 1038 yards, saving 3504 yards; and 3250 yards of concrete footings were reduced to 986 yards, saving 2264 yards.

With wood piles, after excavating to mean low water, shoring and pumping would have been necessary in all trenches, and this saving was estimated at \$4000. A Schedule of

changes showing the saving effected through the use of Raymond Piles is given in the following table:

COMPARATIVE COST OF WOOD PILES AND RAYMOND CONCRETE PILES

WOOD PILES

2193 piles.....	at \$9.50	\$20,835.50
4542 cu.yds.excavation	at .40	1,816.80
3250 cu. yds. concrete	at 8.00	26,000.00
5222 pounds I-beams	at .04	208.88
Shoring and pumping.....		4,000.00
Total cost.....		\$52,861.18

RAYMOND CONCRETE PILES

855 piles.....	at \$20.00	\$17,100.00
1038 cu.yds.excavation	at .40	415.00
986 cu. yds. concrete	at 8.00	7,888.00
Shoring and pumping.....		
Total cost.....		25,403.00
Difference in cost.....		\$27,458.18

The saving in the cost of foundations by the use of Raymond Concrete Piles was more than half of the original cost of the foundations as designed with wood piles.

*"Concrete Piles at the United States Naval Academy," by Walter R. Harper, C. E. Inspector in charge of the Academic Group, U. S. Naval Academy, "Engineering Record," March 4, 1905.

Raymond References

	Location		Owner		Architect or Engineer
ALA.	Langdale—	Mill Buildings	West Point Mfg. Co.		Robert & Co., Engineers
ARK.	Helena—	Helena Courthouse	Phillips County		Frank W. Gibb & Co., Archts.
CALIF.	Hollywood—	Hotel	Hollywood Plaza Hotel Co.		Walker & Eisen, Archts.
		Warehouse	Toberman Estate		Morgan, Walls & Clements, Archts.
	Los Angeles—	Brew House	Los Angeles Brewing Co.		Private Plans
		Baseball Grandstand	Wm. Wrigley, Owner		Zachary T. Davis, Archt.
		Fire Alarm	City of Los Angeles		City Architectural Dept., C. O. Brittain, Mgr.
		Dormitories	County of Los Angeles		County Mechanical Dept., Wm. Davidson, Eng.
		Stores	Frank Strong & Associates		Fred Dorn, Archt.
		Creamery Building	Crescent Creamery Co.		Morgan, Walls & Clements, Archts.
		Police Station	City of Los Angeles		City Architectural Dept., Mr. C. O. Brittain, Mgr.
	San Jose—	Club House	Knights of Columbus		Leo J. Devlin, Archt.
	Santa Monica—	Club House	American Legion		Wm. Allen, Archt.
	Venice—	Theatre	Raymond Amusement Co.		Alfred F. Priest, Archt.
	Hermosa Beach—	Clubhouse	Sand & Surf Club Co.		Myron Hunt, Archt.
	Long Beach—	Hotel	Breakers Hotel Co.		Walker & Eisen, Archts.
	Playa Del Rey—	Clubhouse	Westport Beach Club Co.		Stephen Goosson, Archt.
	San Francisco—	Warehouse and Factory	American Can Co.		N. M. Loney, Engineer
COLO.	Denver—	Auditorium	City of Denver		M. Wilson, Archt.
		Hospital	University of Colorado		Briscoe, Fisher & Fisher, Archts.
	Grand Junction—	Passenger Station	Denver & Rio Grande R. R. Co.		E. J. Yard, Ch. Engr.
CONN.	Hartford—	Factory	Colt Repeating Arms Co.		Aberthaw Const. Co.
		Power Plant	Hartford Elec. Lt. Co.		Stone & Webster, Inc.
	Groton—	Ship Ways	Groton Iron Works		
	Branford—	Machine Shop	Malleable Iron Fitting Co.		
	Montville—	Paper Mill	Bigelow Harriman Co.		
DELA.	Wilmington—	Fuel Oil Tanks	Atlantic Refining Co.		
		Stack	Pyrates Co., Ltd.		
		Marine Terminal	City of Wilmington		
	Claymont—	Open Hearth	Worth Bros. Steel Co.		
DIST. OF COL.	Washington—	Bureau of American Republics	U. S. Government		
		Factory Building	American Ice Co.		
		Hotel	Continental Hotel Co.		
		Theatre Bldg.	Cosmopolitan Theatre Co.		
		Power House	Washington Hotel Company		
		Ericsson Monument	U. S. Government		
		Apartment House	Chas. D. Sager		
		Apartment House	B. Robbins		
		Field House	U. S. Government		
FLA.	Miami—	Warehouse	S. Kann & Sons		
	Miami Beach—	Venetian Way	Bay of Biscayne Improvement Co.		
		Floridian Hotel	Floridian Hotel Company		
		Skew Bridge	Normandy Beach Development Co.		
		Residence and Garage	Carl G. Fisher		
	Palm Beach—	Hotel Alba	So. Florida Realty Company		
		Seawall	Rodman Wanamaker, 2nd		
	St. Petersburg—	Dock	City of St. Petersburg		
	Tampa—	Hotel	Tampa Terrace Hotel Company		
		Ice Plant	Consumers Ice Company		
	West Palm Beach	Comeau Office Building	A. J. Comeau		
GA.	Atlanta—	Telephone Building	Southern Bell Telephone Co.		
		Spring Street Viaduct	City of Atlanta		
		Garage	Ivy Street Corporation		
		Stadium	Georgia School of Technology		
		Office Building	Citizens & Southern Bank		
		Telephone Exchange	Southern Bell Tel. & Tel. Co.		
		Warehouse	Beck & Gregg		
		Round House	Southern Railway		
	Perry—	Bridge	State Highway Commission		
	Tennille	Bridge	State Highway Commission		
	Waycross—	Bridge	State Highway Commission		
ILL.	Chicago—	Apartment	Hugh McLennan		
		Gas Plant	Peoples Gas Light & Coke Co.		
		Mill Bldgs.	Wisconsin Steel Co.		
		Armory	State of Illinois		
		Factory Bldg.	Western Shade Cloth Co.		
		Church	Catholic Bishop of Chicago		
	E. St. Louis—	Temple	Masonic Order		
		Cahokia Power Plant	Union Electric Light & Power Co.		
	LaSalle—	Warehouse	Standard Oil Co.		
	Waukegan—	Bank Bldg.	Waukegan Safe Deposit Co.		
And more that one hundred others.					
IND.	Buffington—	Power Plant	Universal Portland Cement Co.		Private Plans
	Culver—	Cavalry Barn	Culver Military Academy		Albert Knell
	Evansville—	Waterworks	City of Evansville		Alvord, Burdick & Howson
	Ft. Wayne—	Gas Holder	Northern Indiana Gas & Elect. Co.		Private Plans
	Gary—	Mill Buildings	American Sheet & Tin Plate Co.		G. C. Kimball, Ch. Engr.
	Indiana Harbor—	Coke Ovens	Inland Steel Co.		The Koppers Co.
	Mark—	Mill Buildings	Youngstown Sheet & Tube Co.		H. Ovesen, Ch. Engr.
	Fairland—	Bridge	Indianapolis & Cincinnati Ry. Co.		Jeup & Moore
	St. Marys—	School Buildings	Sisters of Providence		D. A. Bohlen & Son
	South Bend—	Office Bldg.	Tuttle Bldg. Corp.		Vonnegut, Bohn & Mueller
IOWA	Burlington—	High School	City of Burlington		Eckland & DeArment
	Cedar Rapids—	Court House	Marion County		Jos. W. Royer
	Council Bluffs—	Office Bldg.	Park Building Corp.		Anderson & Spooner
	Davenport—	Music Pavillion	City of Davenport		Clausen, Kruse & Klein
	Des Moines—	Warehouse	Hewitt Grocery Co.		Proudfoot, Bird and Rawson
		Office Bldg.	Equitable Life Ins. Co. of Iowa		Proudfoot, Bird and Rawson
		Power Plant	Des Moines Electric Co.		Illinois Power and Light Corp.
	Muscatine—	City Hall	City of Muscatine		Jos. E. Mills & Son
	Sioux City—	Court House	Woodbury County		Wm. L. Steel
		Office Bldg.	Warnock Building Co.		Wm. A. Klinger
KANS.	Wichita—	Riverside Park Dam	City of Wichita		Burns & McDonnell, Engrs.
		Retaining Wall	Wichita Terminal Ry.		C. S. Skinner, Resident Engr., A. T. & S. F. Ry.
	Pleasanton—	Bridge	State of Kansas		State Highway Department
	Salina—	Office Building	National Bank of America		Wight & Wight, Archts.
KY.	Louisville—	Power Plant	Belknap Hdw. & Mfg. Co.		Graham, Anderson, Probst & White
		Elevator	Kentucky Public Elevator Co.		Witherspoon-Englar Co.
		Power Plant	Louisville Railways Co.		D. X. Murphy & Bro.
		Power Plant	Kentucky Electric Co.		Sargent & Lundy
		Bridge	C. C. C. & St. L. R. R. Co.		G. P. Smith, Ch. Engr.
	Paducah—	Bridge	City of Paducah		Wilbur J. Watson

Raymond References

	Location	Owner	Architect or Engineer			
LA.	Alexandria—	Orphanage	Jones, Roessle, Olshner & Weiner, Archts.			
	Shreveport—	Bank & Office Bldg.	Emile Weil			
		Office Bldg.	Mann & Stern, Archts.			
	Monroe—	Bank & Office Bldg.	E. F. Neild, Archt., Jens Braae-Jensen, Engrs.			
	New Orleans—	Factory Bldg.	A. S. Gottlieb, Archt., Alexander Brociner, Engr.			
		Public Library	W. H. Lester, Engr.			
		Mill Building	Diboll, Owens & Goldstein, Archts.			
			McKenzie & Goldstein, Archt.			
MAINE	Portland—	High School	Poor & Thomas			
		Warehouse	Webster & Libby			
		Bakery	Webster & Libby			
MD.	Baltimore—	Schools, Police Building, Incinerators, Bridges, etc.	City of Baltimore	C. M. Osborne, Building Inspector		
		Office Bldg.	Standard Oil Co.	Clyde N. Friz, Archt.		
		Pier, Warehouse and Stack Foundation	J. S. Young Co.	C. Montgomery Anderson, Archt.		
		Apartment Building	St. Paul Court Apts.	Edw. L. Palmer, Jr., Archt.		
		Concrete Pier	Standard Oil Co.	Raymond Concrete Pile Co., Engrs.		
		Manufacturing Bldg.	Coca Cola Co.	Louis B. Wilcox, Engr.		
		Sand and Gravel Bins	Arundel Corporation	Raymond Concrete Pile Co., Engrs.		
		Warehouse	Whitaker Paper Co.	Haskell & Barnes, Archts.		
		Row of dwellings	Cleveland R. Bealmear	Geo. Wessel, Archt.		
		Gas Generator House, Condenser, etc.	Consolidated Gas, Electric Lt. & Pr. Co.	Owner		
	Annapolis—	Academic Group	U. S. Government	Ernest Flagg, Archt.		
		U. S. Naval Academy				
	Hagerstown—	Wharf	U. S. Government	Ralph Whitman, Asst. Ch. Engr., U. S. N.		
		Warehouse	D. A. Stickell & Sons	Baxter Engr. & Appraisal Co.		
	Sparrows Point—	Concrete Shipways, Marine Railway Piers, Ore Dock, Ore Bins, Trestle, Coke Ovens, Pumping Station, etc.	Bethlehem Steel Co.	H. C. Lane, Ch. Engr.		
		And more than one hundred others.				
		MASS.	Boston—	Army Base	U. S. Government	Fay, Spofford & Thorndike
Round House				N. Y. N. H. & H. R. R. Co.	Stone & Webster, Inc.	
Craneway	Bethlehem Ship Co.			Bethlehem Ship Co.		
Memorial	Park Com. (City of Boston)			F. A. Burdet & Co.		
Quincy—	Ship Bldg. Plant		Fore River Ship Bldg. Co.	Monks & Johnson		
	Tank & Bldgs.		N. E. Oil Refining Co.	French & Hubbard		
New Bedford—	Bulkhead		Pocahontas Coal Co.	H. S. Adams		
	Building Foundation		Revere Sugar Co.	Wm. Higginson, Archt.		
Charlestown—	Bridge		City of Springfield	City of Springfield		
	Boiler House		United Elec. Co.	McClintock & Craig		
Springfield—	Mill	Washington Mills	John A. Stevens			
	Mill	Geo. W. Prentiss & Co.	Bliss & La Valle			
	Mill	International Cotton Co.	Lockwood Greene & Co., Inc.			
MICH.	Flint—	Industrial and Assembly Buildings	Chevrolet Motor Co.	W. E. Wood Company		
		Motors Bldg.	Mason Motor Co.	W. E. Wood Company		
		Sub-Station	Consumers Power Co.	Hodenpyl Hardy & Co.		
		School	City of Owosso	Lane, Davenport & Peterson		
		School	Village of Clawson	Lane, Davenport & Peterson		
		School	City of Port Huron	Geo. L. Harvey, Archt.		
		Paper Plant	Kalamazoo Paper Co.	W. H. Scott, Engr.		
		Sub-Station	D. T. & I. R. R.	Albert Kahn, Inc.		
		Residence	R. H. Webber	Robt. Derrick, Inc.		
		Residence	John Dodge	Smith, Hinchman & Grylls		
	Owosso—	Filtration Plant	City of Detroit	Theo. A. Leisen		
		Stack Foundation	American Products Co.	Mildner & Eisen		
		Power House and Nine Other Bldgs.	Ford Motor Company	W. B. Mayo, Engr., Albert Kahn, Archt.		
		Gas Plant	Detroit City Gas Co.	The Koppers Company		
		Whittier Apt.	Louis Smilansky	Chas. N. Agree		
		Group of Bldgs.	Marygrove College	D. A. Bohlen & Son		
		MINN.	Duluth—	Freight House	C. St. P. M. & O. R. R.	Railroad Engrs.
				Freight House	C. St. P. M. & O. R. R.	Railroad Engrs.
Round House	C. St. P. M. & O. R. R.			Railroad Engrs.		
Mankato—	High School		City of Minneapolis	Board of Education, Engrs.		
	Orphanage		St. Otto's Orphanage	C. A. P. Turner, Minneapolis		
	Warehouse		Farwell, Ozmun, Kirk & Co.	Butler Bros., Contr. & Engr.		
Minneapolis—	Warehouse	Lindeke-Warner	Butler Bros., Contr. & Engr.			
	Robert St. Br. Approach	St. Paul	Toltz, King & Day			
MISS.	Jackson—	Gas Plant	Jackson Gas & Electric Co.	U. G. I. Co., Engrs.		
		Office Bldg.	Lamar Life Insurance Co.	Sanguinet, Staats & Hedrick, Archts.		
		Office Bldg.	Mississippi Fire Ins. Co.	N. W. Overstreet, Archt.		
		Church	First Baptist Church	N. W. Overstreet, Archt.		
	Vicksburg—	Y. M. C. A.	Vicksburg Y. M. C. A.	Shattuck & Laver, Archts.		
MO.	St. Louis—	Post Office	Federal Government	Supervising Archt., U. S. Treasury		
		Settling Basin (Chain of Rocks)	City of St. Louis	St. Louis Water Department Engrs.		
		Factory	Bemis Bag Co.	W. H. Lester, Engr.		
		Factory	Carr-Trombley Mfg. Co.	Albert B. Groves, Archt.		
		Viaduct, 14th Street	City of St. Louis	L. R. Bowen, Engr.		
	Kansas City—	Factory (2)	Bemis Bag Co.	Bemis Bros. Bag Co., Engrs.		
		Retaining Walls	K. C. Terminal Railway	John V. Hanna, Ch. Engr.		
		Grain Elevator	Rock Island Lines	McDonald Engr. Co., Engrs.		
		Warehouse	Sears-Roebuck Co.	Geo. C. Nimmons & Co., Archt.		
		Union Station Train Sheds	K. C. Terminal Railway	Jarvis Hunt, Archt.		
	St. Joseph—	9 Viaducts	Railroads and City	Railroad and City Engrs.		
		Warehouse	Jenkins Music Co.	Smith, Rea & Lovitt, Archt.		
		Stack	Armour & Co.	R. C. Clark, Archt.		
		Bank Bldg.	Bartlett Trust Co.	Starrett & VanVleck, Archts.		
		350 foot Stack	St. Joseph Lead Co.	Heine Chimney Co., Engrs.		
	Crystal City—	Glass Furnace	Pittsburgh Plate Glass Co.	J. H. Fox, Ch. Engr.		
	And more than fifty others.					

Raymond References

	Location		Owner		Architect or Engineer
NEBR.	Omaha—	Hotel	Rome Miller		John Latenser & Sons, Archts.
		Telephone Exchange	Omaha Telephone Co.		Geo. B. Prinz, Archt.
		Office Building	Omaha Grain Exchange		F. A. Henninger, Archt.
		Office Building	Standard Oil Co.		McDonald & McDonald, Archts
		North Technical High School	City of Omaha		Clark & Clark, Archts.
N. H.	Concord— Lakeport— Manchester—	Dental Bldg. and Grandstand	Creighton College		John Latenser & Sons, Archts.
		Warehouse	Nebraska Power Co.		F. C. Stott, Archt.
		Round House	Boston & Maine R. R.		Boston & Maine R. R.
		Machine Shop	Scott & Williams		Lockwood, Greene & Co., Inc.
		Bridge	City of Manchester		Fay Spofford & Thorndike
N. J.	Nashua— Portsmouth—	Retort Bldg.	Manchester Gas Co.		U. G. I. Contracting Co.
		Sub-Station	Nashua Mfg. Co.		John A. Stevens
		Engine House	Boston & Maine R. R.		Boston & Maine R. R.
	Bayonne—	Tanks & Buildings	Standard Oil Co. of N. J.		Owners Plans
		Tanks	Tidewater Oil Co.		Owners Plans
N. Y.	Camden—	Telephone Buildings	Delaware & Atlantic Tel. Co.		John T. Windrim, Archt.
		Factory	Victor Talking Machine Co.		Stone & Webster, Engrs.
		Warehouse	Van Sciver Furniture Co.		Ballinger Co., Archts.
		Factory Building	Otis Elevator Co.		W. O. Moyer, Archt.
		Buildings	Crucible Steel Company		W. H. Taylor, Engr.
N. Y.	Newark—	Factory Building	Pittsburgh Plate Glass Co.		Dwight P. Robinson Co., Engrs.
		Office Building	Chamber of Commerce		Gilbert & Betelle, Archts.
		Hotel	Ocean Front Hotel		Vivian B. Smith, Archt.
	Ocean City—	Warehouses	Standard Oil Co. of Buffalo		John W. Cowper Co., Engrs.
		Schools	City of New York		Wm. H. Gompert, Archt.
N. Y.	Buffalo— New York City—	Buildings	New York Telephone Co.		McKenzie, Voorhees, Gmelin, Archts
		Train Sheds	Board of Transportation		Robt. Ridgeway, Ch. Engr.
		Office Building	Knit Goods Building		Christian J. Jeppesen, Engr.
		Warehouse	The Macey Company		Robt. D. Kohn, Archt.
		Hospital Buildings	University of Rochester		Gordon & Kaelber, Archt.
N. Y.	Rochester— Schenectady— Syracuse— Utica—	Hotel	Schenectady Hotel Co., Inc.		H. L. Stevens & Co., Archt.
		Gas Plant	Syracuse Lighting Co.		U. G. I. Contracting Co., Engrs.
		Gas Plant	Utica Gas & Electric Co.		Thos. E. Murray, Inc., Engrs.

And more than 250 others.

N. C.	Greenville— Wilmington— Williamston— Biltmore— Hendersonville— Greensboro— Charlotte—	Teachers College	State of North Carolina		H. A. Underwood
		Court House	New Hanover County		Leslie N. Boney
		Bridge	State Highway Department		Frank L. Page, Chairman
		Finishing Plant	Sayles Finishing Plants, Inc.		J. E. Serrine & Co.
		Public School	Hendersonville Graded School Dist.		Earl Stillwell
N. C.	Greensboro— Charlotte—	Office Bldg.	Jefferson Standard Life Ins. Co.		C. C. Hartman, Archt.
		Office Bldg.	Anchor Mills Company		W. L. Stoddard
		Film Exchange	T. W. & U. V. Hawkins		C. R. Dewey
		Bridge	State Highway Commission		State Highway Dept. Engrs.
OHIO	Akron—	Water Intake & Bldgs.	Firestone Tire & Rubber Co.		R. R. Jones, Ch. Engr.
		Various Bldgs.	B. F. Goodrich Company		Company Engr.
		Factory Bldg.	American Hard Rubber Co.		Company Engr.
		Various Bldgs.	Goodyear Tire & Rubber Co.		W. C. State, Ch. Engr.
		North Hill Viaduct	Summit County		Harrington, Howard & Ash, Engrs.
OHIO	Cincinnati— Cleveland—	Schools	Akron Board of Education		M. M. Konarski, School Arch.
		Warehouse	Cincinnati Terminal Warehouse Co.		A. M. Allen & Co., Engrs.
		Dennison-Harvord Viaduct	Cuyahoga County		A. M. Felgate, Engr.
		Mill Bldg. Foundations	Otis Steel Company		Company Engr.
		Steel Plant Bldgs.	McKinney Steel Co.		H. Harrison, V. P. & Gen. Mgr.
OHIO	Dayton— Warren— Youngstown—	Factory Bldg.	Dayton Electric Laboratories Company		Company Engr.
		Various Bldgs.	Trumbull Steel Company		Company Engrs.
		Blast Furnaces, Mill Bldgs., Etc.	Youngstown Sheet & Tube Co.		Company Engr.
		Blast Furnaces, Mill Bldgs., Etc.	Republic Iron & Steel Co.		Company Engrs.
OKLA.	Alva— Sand Springs— West Tulsa—	Flour Mill	Kansas Flour Mill Co.		Von Unwerth & Wilson, Engrs.
		Smoke Stack	Sand Spring Light & Power Co.		Clarence Tingley, Archt.
		Stack & Boiler House	Cosden & Co.		Baumes McDevitt Machinery Co., Engrs.
ORE.	Portland—	Distributing Plant	Cudahy Packing Co.		Truscon Steel Co., Engrs.
		Freight House	Union Pacific System		S. Murray, Asst. Ch. Engr.
		Bridge Approach	Union Pacific System		S. Murray, Asst. Ch. Engr.
		Power Station	Portland E. Power Co.		O. B. Coldwell, Vice-President
		Bybee Avenue Bridge	Ladd Estate, S. P. Co.		G. W. Boschke, Ch. Engr.
ORE.	The Dalles—	Viaduct & Retaining Wall	City of Portland		O. Laargard, City Engr.
		Gas Holder Foundation	Portland Gas & Coke		Martin Schacht, Contr.
		Dock Foundation	City Dock Commission		G. B. Hegardt, City Engr.
		Generator Station A	Portland E. Power Co.		O. B. Coldwell, Vice-Pres.
		Depot	Union Pacific System		S. Murray, Asst. Ch. Engr.
PA.	Creighton— Pittsburgh—	Factory Bldgs.	Pittsburgh Plate Glass Co.		J. H. Fox, Executive Engr.
		Warehouse	Crane Company		The Hunting-Davis Co., Archts.
		Manufacturing Bldg.	Standard Underground Cable Co.		Jos. F. Kuntz, Archt.
		Schenley High School	Board of Education		Edward Stotz, Archt.
		Soldiers' and Sailors' Memorial Hall	County of Allegheny		Henry Hornbostel, Archt.
PA.	Rankin— East Pittsburgh— Ambridge— McKeesport— Marcus Hook— Philadelphia—	Manufacturing Bldgs. & Power Plant	H. J. Heinz Company		Company Engrs.
		Power Plant, Ore Bin, etc.	Carnegie Steel Co.		Engrs. of Company
		Factory	Westinghouse Elec. and Mfg. Co.		B. H. Prack, Archt.
		Crane Runway	American Bridge Company		James L. Bernard, Ch. Mech. Engr.
		Mill Bldgs.	National Tube Company		Company Engrs.
PA.	Still Foundations— University Museum— Warehouse— Car Barn—	Still Foundations	Sinclair Refining Company		W. W. Mellan, Local Mgr.
		University Museum	University of Pennsylvania		Stewardson & Page, Archts.
		Warehouse	American Stores Company		A. B. Kister, Archt.
		Car Barn	Philadelphia Rapid Transit Co.		George Stier, V. P., Charge Engrs.

And more than one hundred others.

Raymond References

	Location		Owner	Architect or Engineer
R. I.	Newport— Woonsocket— Providence—	Power House Mill Stadium Office Bldg. Mill	U. S. Government Nyanza Mills Brown University Providence Tel. Co. Revere Rubber Co.	Westinghouse-Church-Kerr Lockwood, Greene & Co., Inc. Gavin Hadden French & Hubbard Lockwood, Greene & Co., Inc.
S. C.	Charleston—	Bank Bldg. Pier Hotel Hotel Dock Bridge (Cove Inlet) Apartment Bridge (Santee River)	Peoples National Bank U. S. Navy Yard Francis Marion Hotel Co. Fort Sumter Hotel Co. Charleston Port Commission State Highway Commission Berkeley Court Apt. Co. State Highway Commission	Thompson & Frohling, Archts. U. S. Navy Dept., Engrs. Wm. Stoddard, Archt. G. Lloyd Preacher, Archt. Owners' Plans State Highway Dept., Engrs. G. Lloyd Preacher, Archt. State Highway Dept., Engrs.
TENN.	Lanes— Chattanooga—	Sand & Gravel Plant Warehouse Warehouse Abutment and piers for Tenn. River Bridge	Bible Sand Co. Tennessee Furniture Co. Casey-Hedges Co.	Private Plans Clarence T. Jones, Archt. C. E. Bearden, Archt.
	Knoxville—	Gay Street Viaduct Abutments Office Bldg.	Southern Ry. Co. City of Knoxville Tennessee General Co. Central Bank & Trust Co.	Southern Ry. Co., Engrs. Southern Ry. Co., Engrs. Barber & McMurphy, Archts.; Spiker & Lose, Engrs. J. G. Rogers & N. M. Woods, Jr., Asso. Archts. Gunvald-Aus, Engrs. Boyer, Baum & Co., Engrs.
	Memphis—	Bank Bldg.	Columbian Mutual Life Insurance Co.	
TEXAS	Houston—	Office Bldg. 1750 ft. Warehouse Platform Office Bldg.	Houston Compress Company Mrs. Neils Esperson, The Humble Oil & Refining Co. The Humble Oil & Refining Co. Gulf Refining Co. Imperial Sugar Company State National Bank	R. J. Cummins, Engr. John Eberson, Archt., Chicago Raymond Concrete Pile Co. Raymond Concrete Pile Co. George S. Davison, Pres. Dwight P. Robinson, Archt. C. D. Hill & Co. Archts.
	Baytown—	600 ft. Concrete Oil Dock 400 ft. Concrete Oil Dock 1500 ft. Concrete Oil Dock		
	Port Arthur— Sugar Land— Corsicana—	Sugar Refinery Office Bldg.		
VA.	Alexandria— Norfolk—	Naval Torpedo Assembly Plant Building Foundation Sea Plane Runways Quay Wall City Pier Export Pier	War Department Chesapeake-Potomac Tele. Co. Navy Dept. U. S. Government Navy Dept. U. S. Government City of Norfolk Imperial Tobacco Co. of Great Britain & Ireland U. S. Government Richmond, Fredericksburg & Potomac S. P. & S. Railway G. N., N. P., & U. P. Rys. L. C. Smith Co. Union Pacific System American Can Co.	War Department McKenzie, Voorhees & Gmelin Bureau Yards & Docks Bureau Yards & Docks Folwell & Ahlskog Neff & Thompson U. S. Government Engrs. Carneal & Johnson S. J. Witchell, Ch. Engr. Oscar Bowen, A. R. Cook and S. Murray Gaggin & Gaggin, Archts. S. Murray, Asst. Ch. Engr. Preis, Ch. Engr.
	Richmond—	Mooring Pier Union Depot		
WASH.	Cooks— Seattle—	Bridge Abutment Fourth Avenue Viaduct L. C. Smith Bldg. Freight House Manufacturing Bldgs.		
	Spokane—	Viaducts & Retaining Walls		
	Tacoma—	Puyallup Viaduct Gallagher's Gulch Arch	Union Pacific City of Tacoma City of Tacoma Monongahela Traction Co. Wheeling Steel Corporation	S. Murray, Asst. Ch. Engr. J. C. Manley, City Engr. J. C. Manley, City Engr. Wilbur Watson, Engr. Company Engrs.
W. VA.	Hutchinson— Wheeling—	Power House Crane Runway		
WIS.	Milwaukee—	Appraisers Stores Straus Building Factory School Bldg. Garage Addition Warehouse Bottling Plant Factory Buildings Bank Bldg.	Federal Government Arthur J. Straus Co. E. Wiener Co. St. Rose's School Michael Ert Deaconess Hospital Schlitz Brewing Co. Waukesha Milk Co. Aluminum Goods Mfg. Co. Security Nat'l. Bank	Supervising Archt. Treas. Van Ryn & DeGelleke, Archts. Dick and Bauer Eschweiler & Eschweiler M. Tullgren & Sons Leiser & Holst Kirchhoff & Rose Federal Engrg. Co. Lockwood Green & Co. Brust & Philipp.
	Manitowoc— Sheboygan—			

Canada

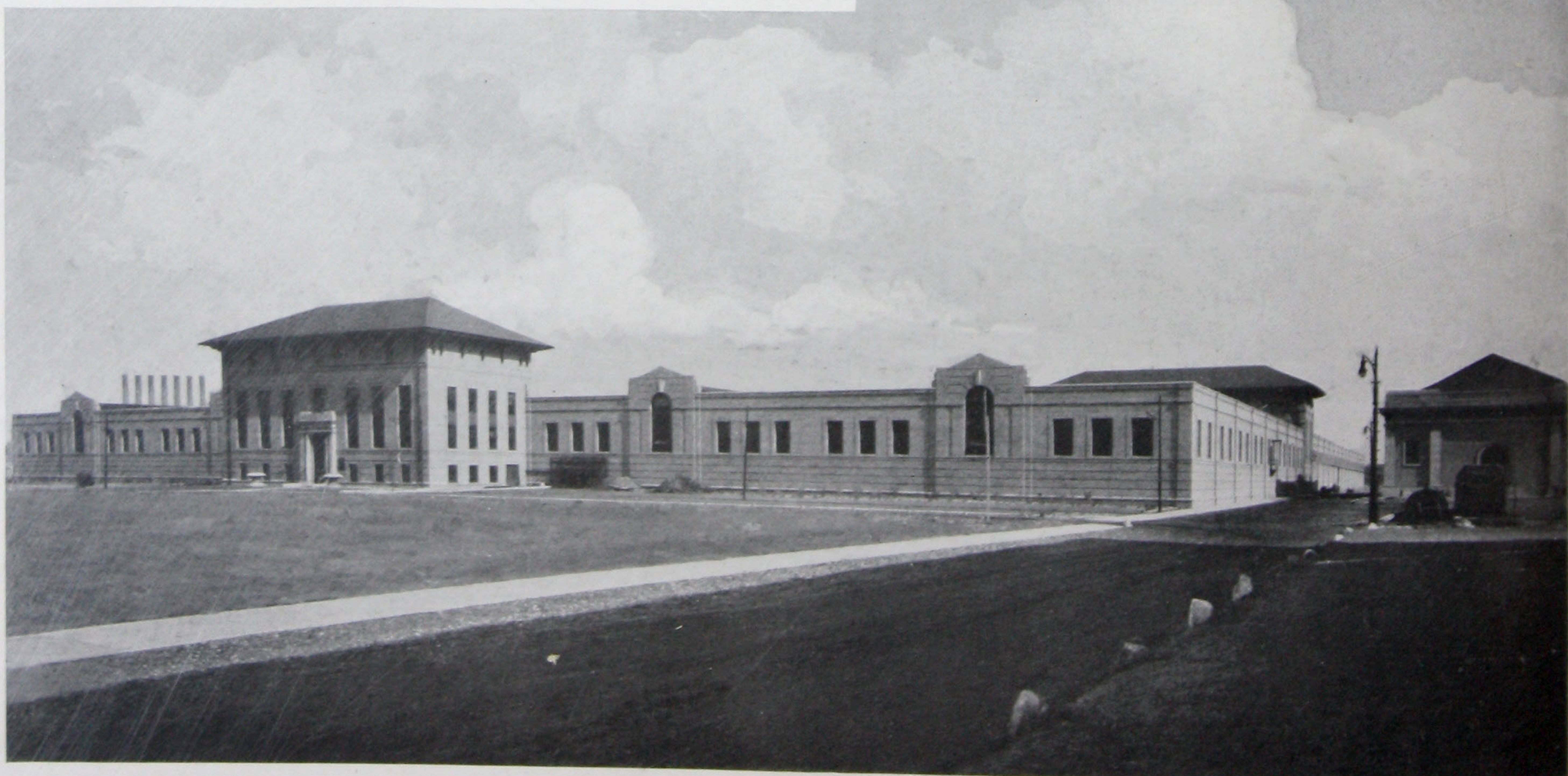
QUE.	Montreal—	Sheds & Piers (7 Contracts) Grain Elevator, etc. Manufacturing Plant Telephone Exchanges Factory Factory Theatre Grain Elevator Grain Elevator Bank Sub-Station Office Building Actifer Towers Church	Montreal Harbour Comm. Montreal Harbour Comm. Northern Electric Bell Telephone Co. Martin Senour Paint Co. Wherwin Williams Co., Ltd. Allan Theatre Company Dominion Linseed Oil Co. Canada Linseed Oil Co., Ltd. Molsons Bank Montreal Tramways Drummond McCall Co., Ltd. Mtl. L. H. & P. Cons. St. James The Apostle Belgo Can. Paper Co., Ltd. Can. Pacific Railway Price Bros., Ltd. Ha Ha Bay Sulphite Co. Riordon Paper Co., Ltd.	F. W. Cowie, Ch. Engr. J. S. Metcalf Co. W. J. Carmichael Company Engr. W. B. McLean T. Pringle & Sons
	Shawinigan Falls— Quebec City— Riverbend— Bagotville— Hawkesbury—	Paper Mills (6 contracts) Freight Sheds Paper Mills Paper Mills Paper Mills (6 contracts)	Can. Pacific Railway Can. Pacific Railway Can. Pacific Railway Can. Pacific Railway Can. Pacific Railway	J. W. Bowman J. S. Metcalf Co. Turner & Carless Owners F. G. Robb Company's J. S. Archibald J. Stadler Owners Geo. F. Hardy J. G. White, Engr. Corp. C. B. Thorne
ALTA.	Lethbridge— Old Man River— Outlook River— Brocket River— Edmonton—	Viaduct Bridge Bridge Bridge High Bridge	Can. National Railway Province of Sask. Newfoundland P. & P. Co. Fort William Paper Co.	Owners Owners Owners Owners Owners
SASK.	Regina—	Qu'Appelle Hotel Parliament Bldgs.		Ross & McDonald E. & W. S. Maxwell Sir. W. G. Armstrong Whitworth Co. Dayton Engr. Co.
	Newfoundland—	Paper Mills		
ONT.	Fort William—	Paper Mill		



ABOVE—Cincinnati Terminal Warehouse, Cincinnati, Ohio. More than 5000 Standard Raymond Concrete Piles in the foundation. A. M. Allen Co., Architects.

LEFT—Equitable Life Ins. Co. of Iowa, Office Building at Des Moines, Iowa. Proudfoot, Bird & Rawson, Architects.

BELOW—Filtration Plant at Detroit, Michigan, in the foundation of which more than 15,000 piles were used, about 60% being of the composite type and about 40% Standard Raymond Concrete Piles, the former being used wherever the required length was too great for Standard piles. Theo. Leisen, Ch. Eng.





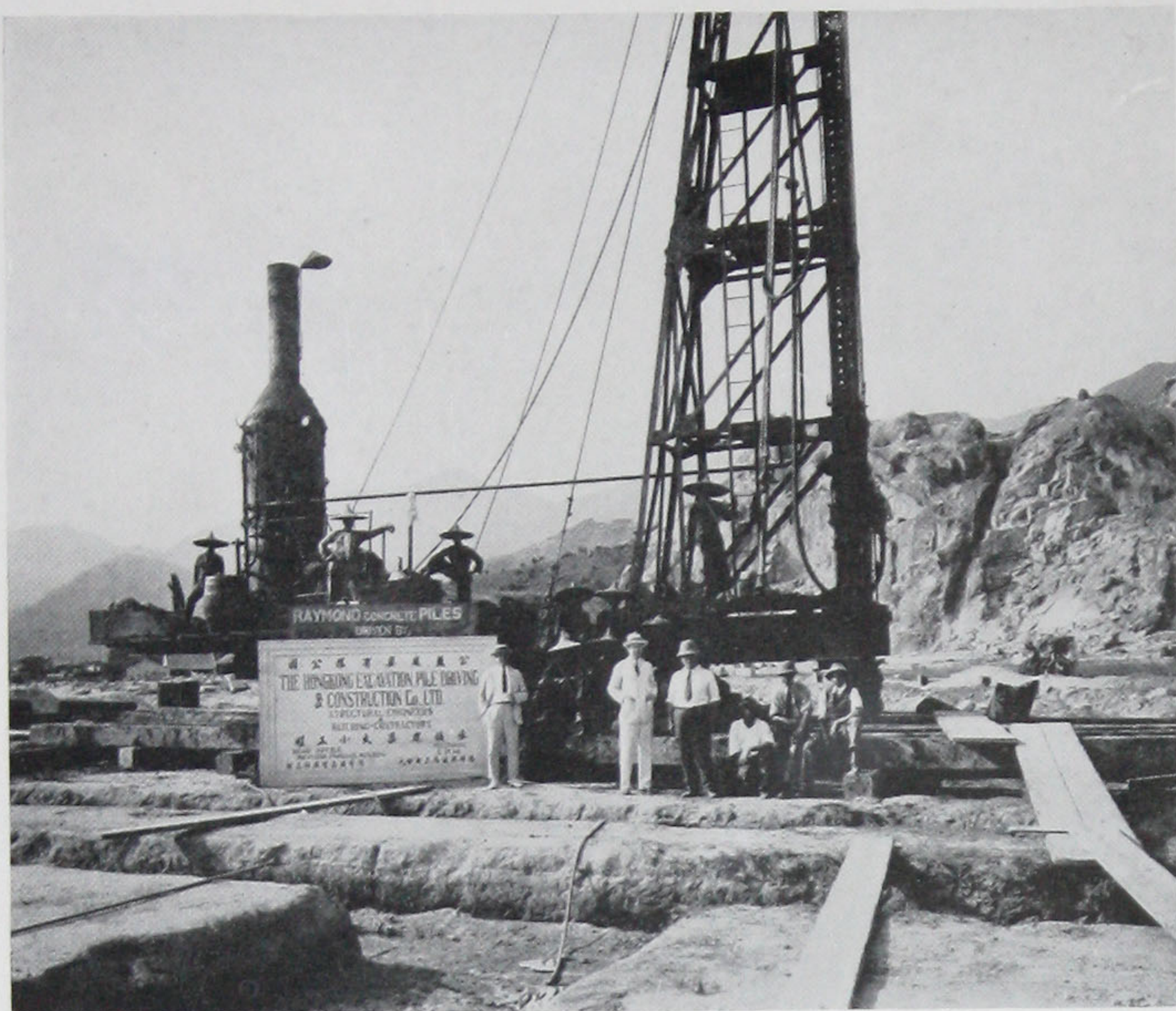
Northern Electric Building, Montreal, Canada.

Columbia Mutual Life Assurance Society
Memphis, Tenn.

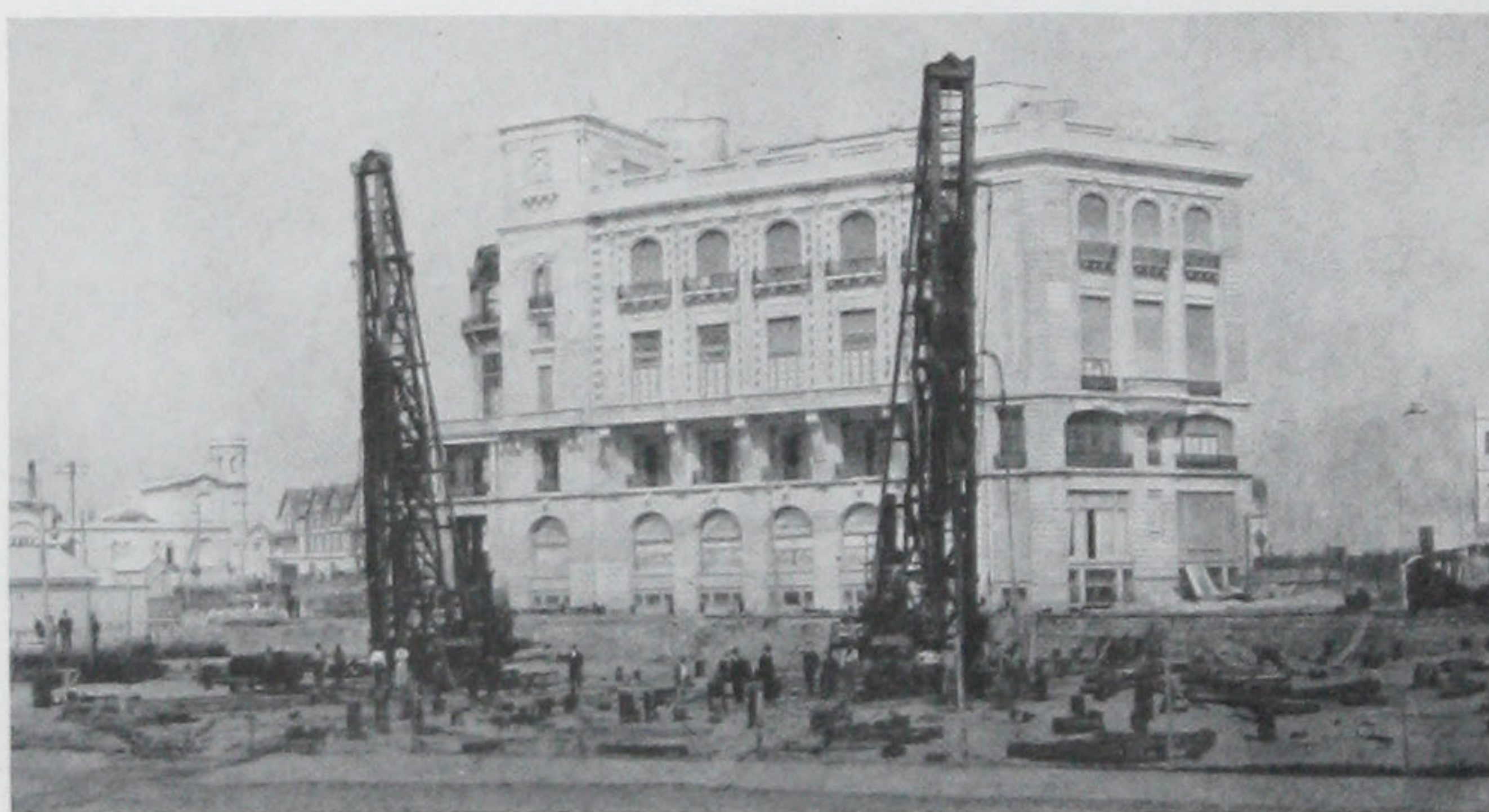


Below: Jefferson Junior High School, Minneapolis, Minn.



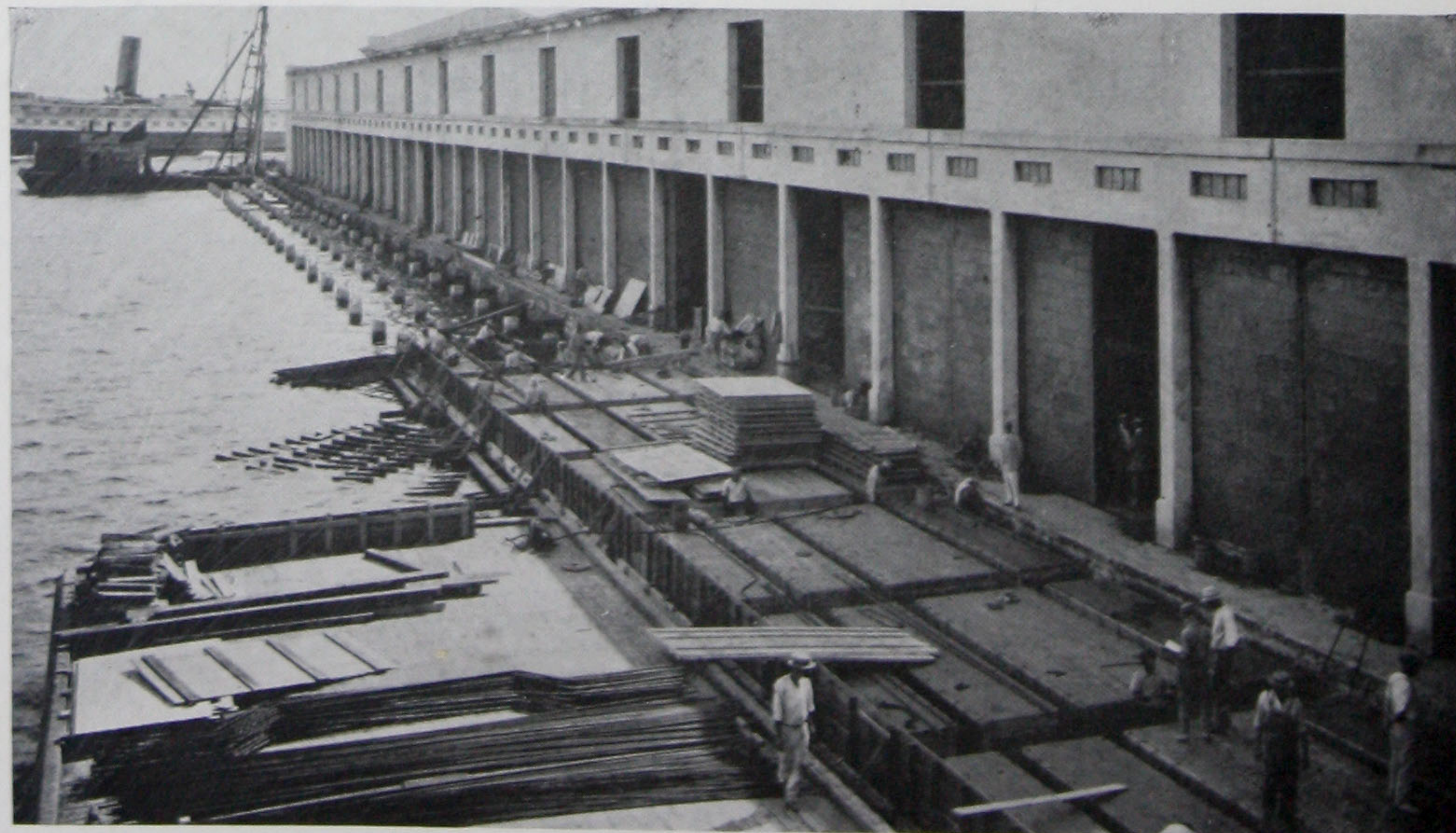


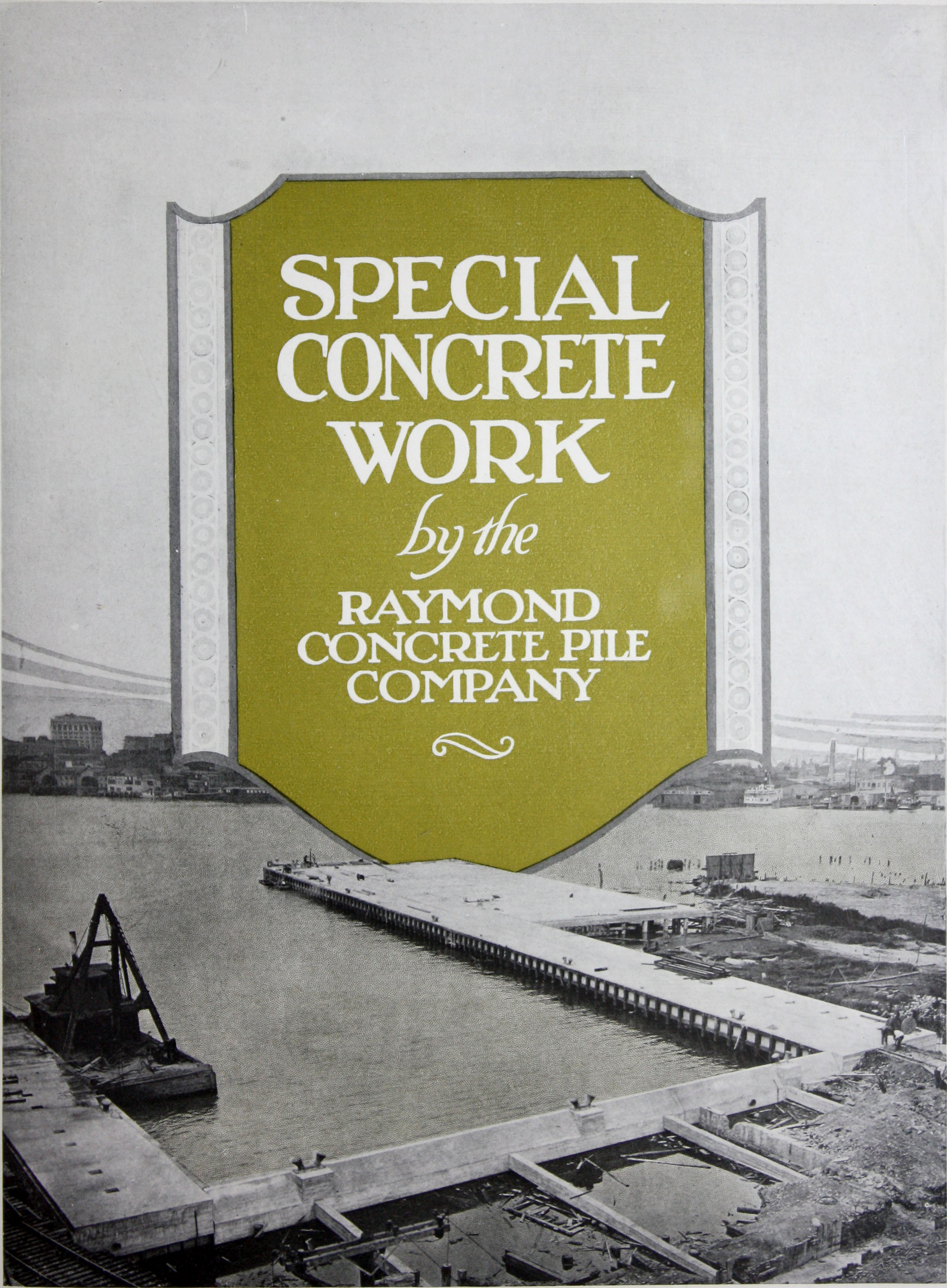
Driving Raymond Concrete Piles for the foundation of a jail for the Colonial Government at Hong Kong, China



La Rambla, Mar del Plata, Argentine, South America, supported on 7000 Raymond Concrete Piles

Dock at Havana, Cuba





SPECIAL CONCRETE WORK

by the
RAYMOND
CONCRETE PILE
COMPANY



Concrete Bulkhead and Wharf, Imperial Tobacco Co., Norfolk, Va.

Special Concrete Work

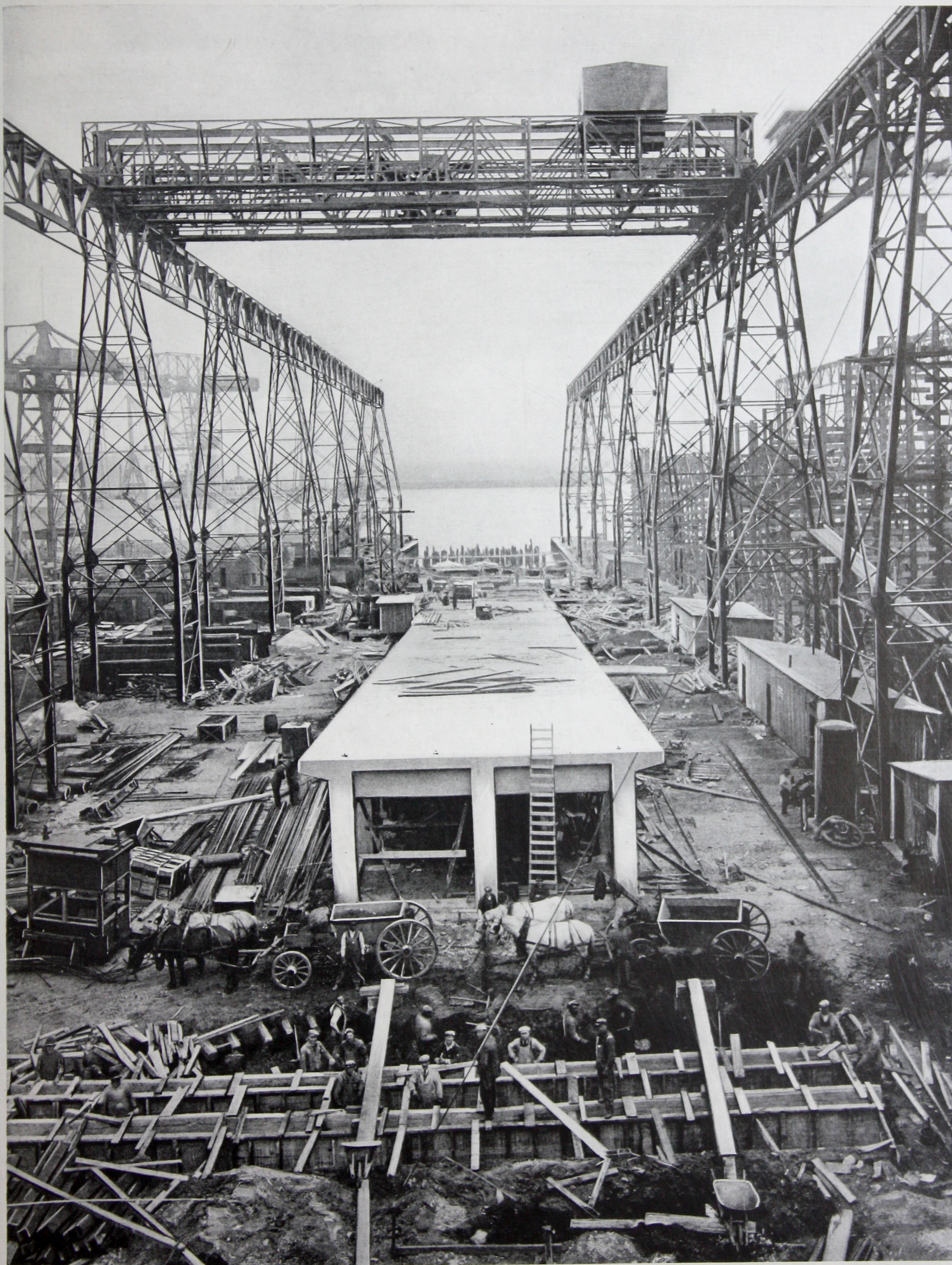
IN presenting the following pages, we have sought to show examples of reinforced concrete construction which are of special interest to Engineers, and which will convey an impression of the character of work in which we specialize.

It will be noted that, in addition to the placing of Standard Raymond Concrete Piles for foundations of structures on land, we construct and design permanent docks, piers, bulkheads, trestles, storage bins, retaining walls, bridges, heavy foundations, shipways, drydocks, etc., etc.

Each problem requires special study for its proper solution.

Our experience and our organization are yours to command.

May we serve you?



First reinforced concrete shipway for the Wm. Cramp & Sons Ship and Engine Building Company, Philadelphia, Penna.



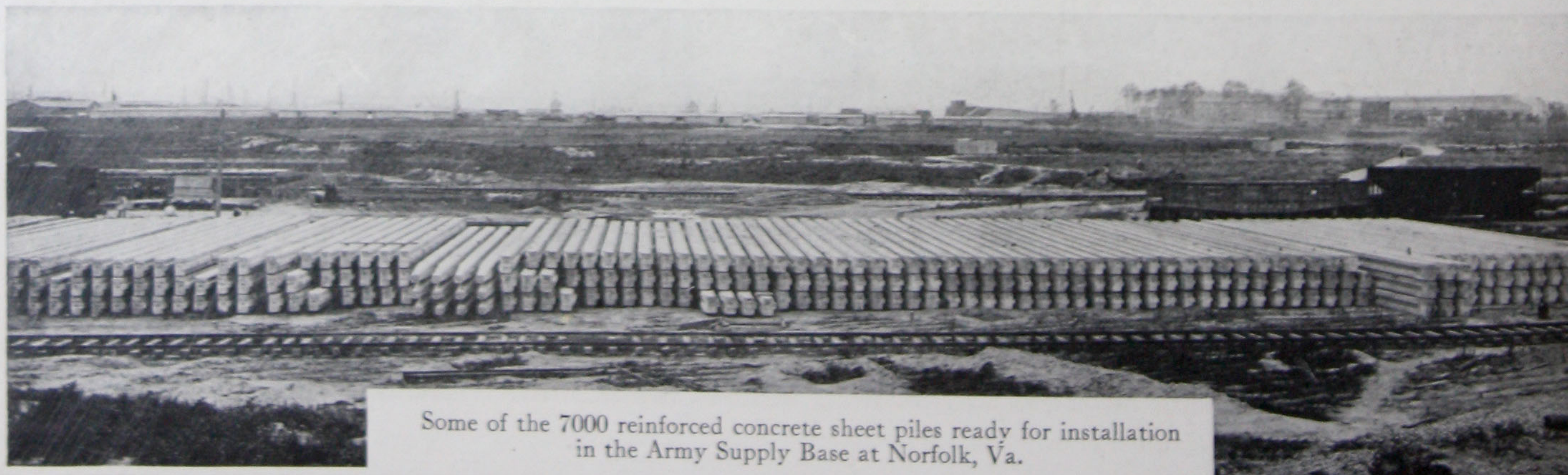
Reinforced concrete pier for Standard Oil Company, Baltimore, Md.



Ferry Slip Approach, Baltimore & Eastern Shore Ferry Company, Bay Shore, Baltimore, Md.



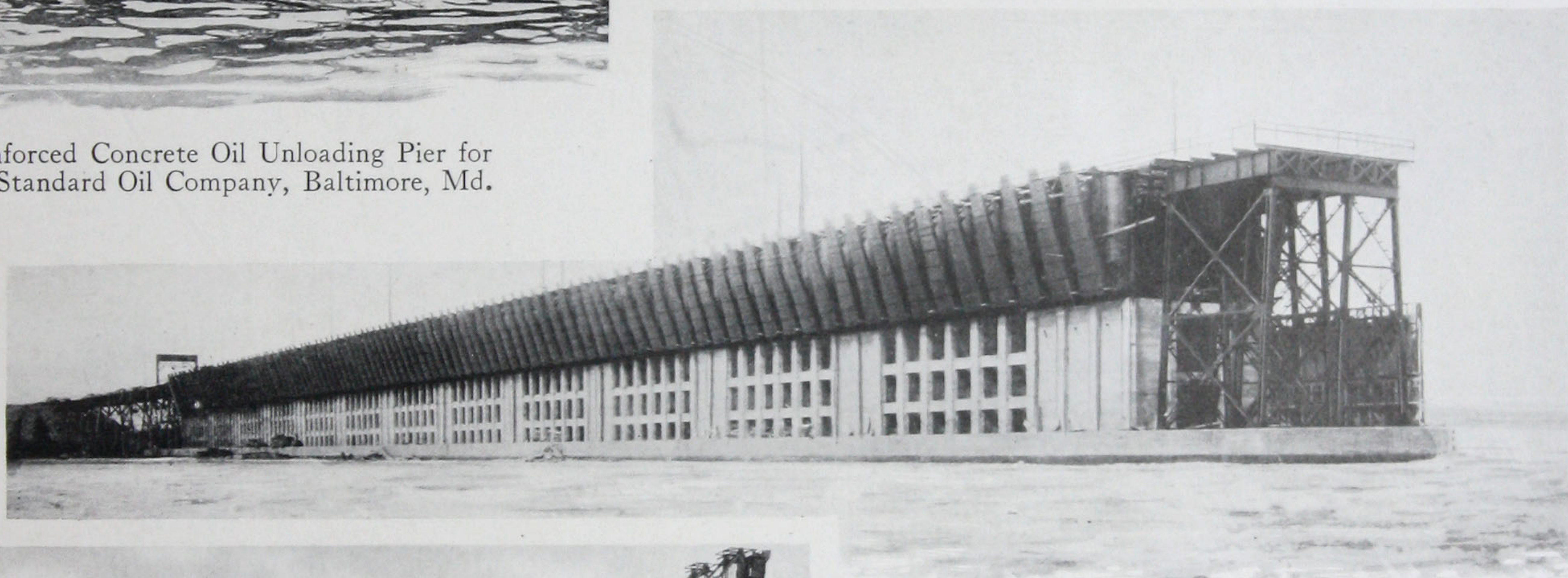
Reinforced concrete highway bridge over the Miles River at Easton, Maryland. (Pre-cast unit construction.)



Some of the 7000 reinforced concrete sheet piles ready for installation in the Army Supply Base at Norfolk, Va.



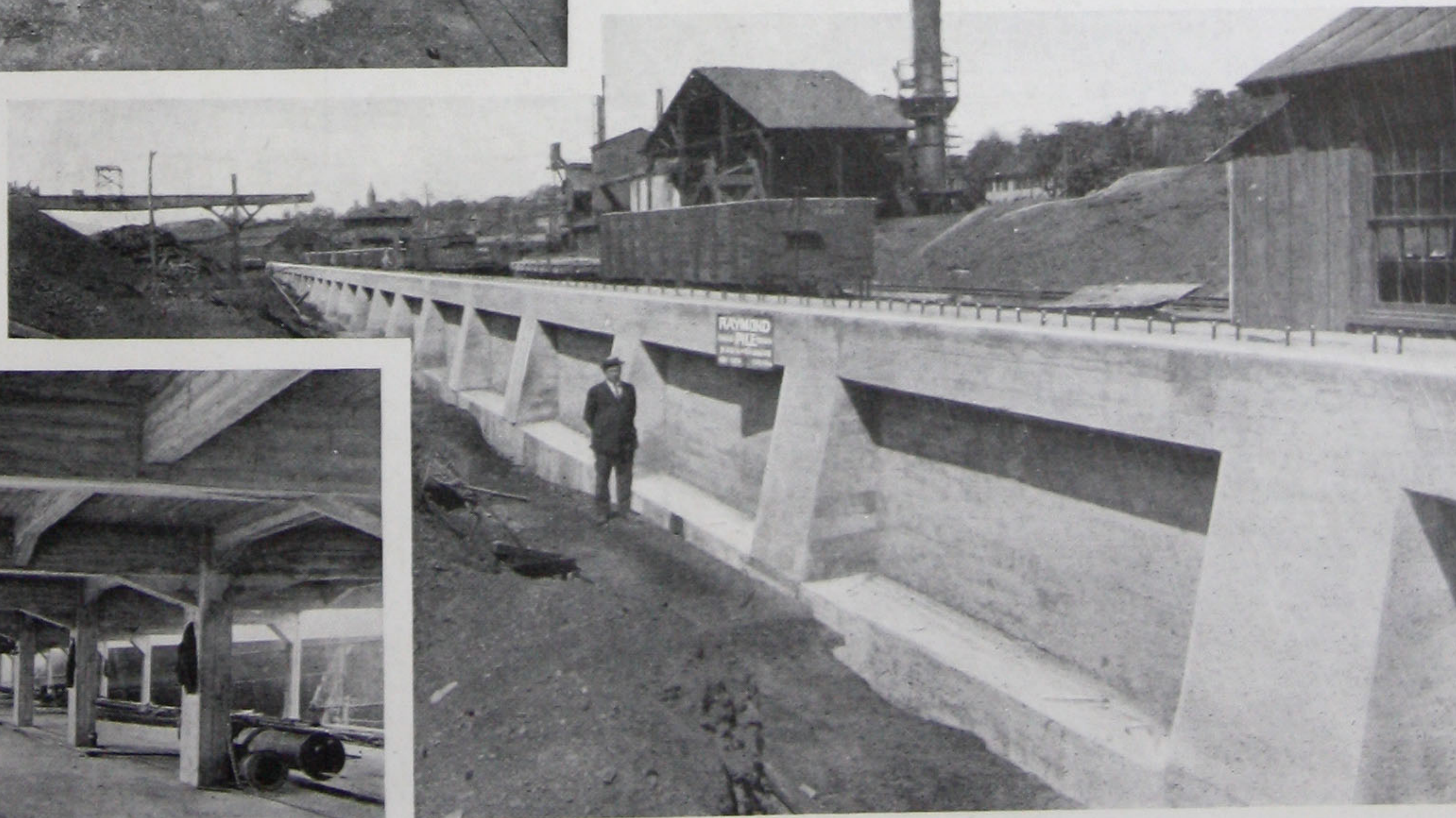
Reinforced Concrete Oil Unloading Pier for the Standard Oil Company, Baltimore, Md.



Ore Unloading Trestle for the Bethlehem Shipbuilding Corporation, Sparrows Point, Md.

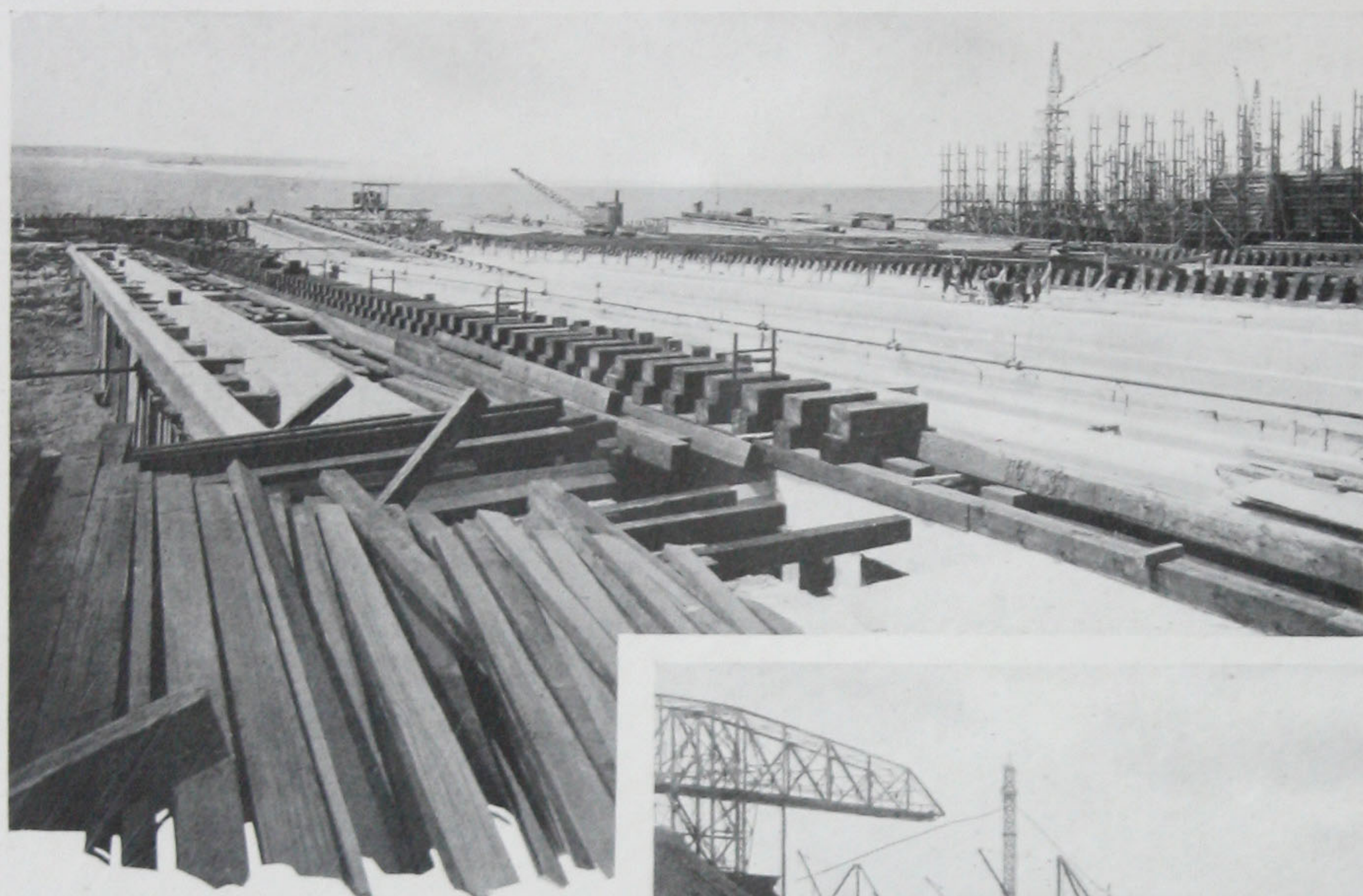
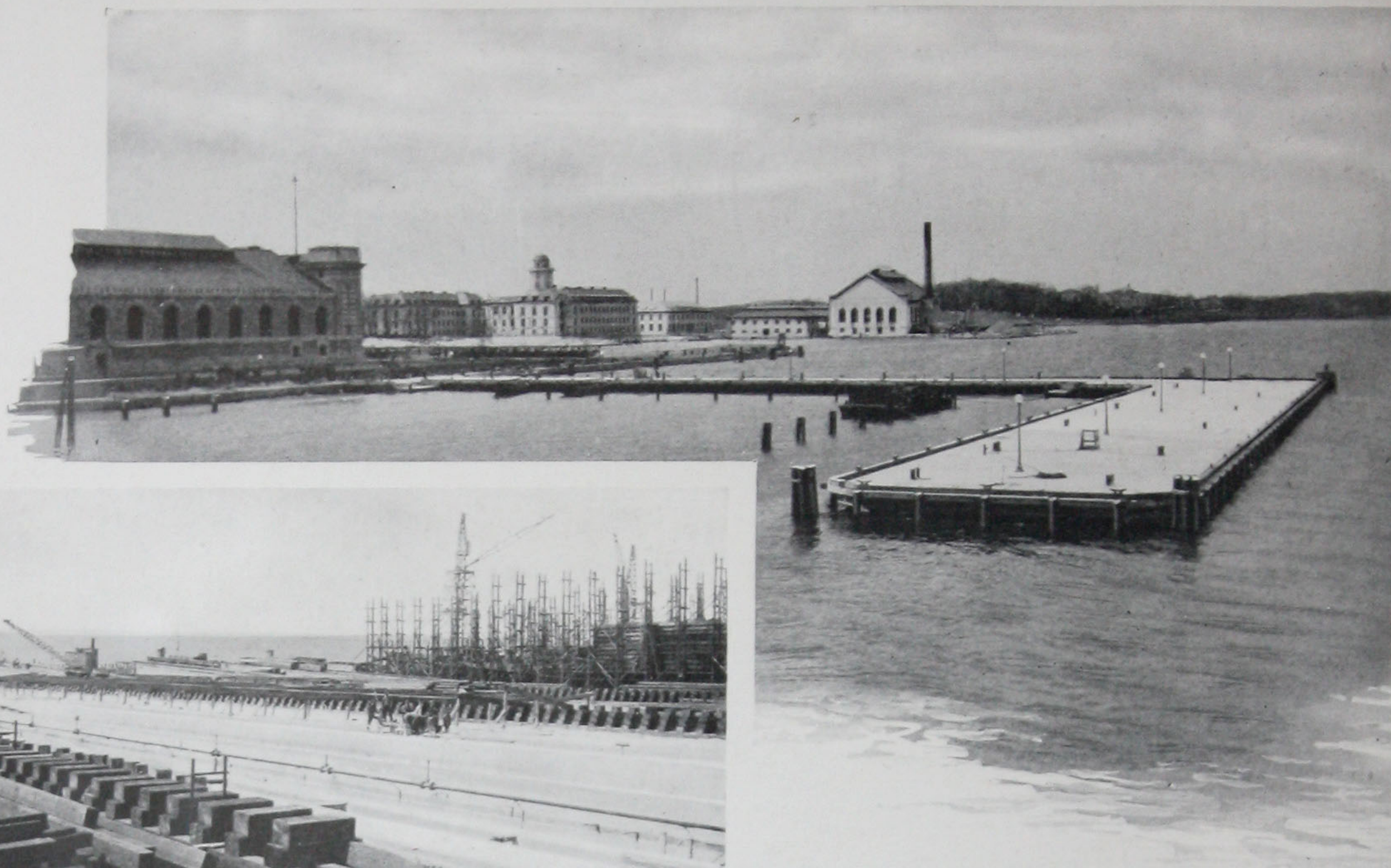
Twelve Hundred Foot Concrete Ore Unloading Dock for the Lake Superior and Ishpeming Railroad, Marquette, Mich.

Retaining wall and track support for the Bethlehem Steel Company, Steelton, Penna.

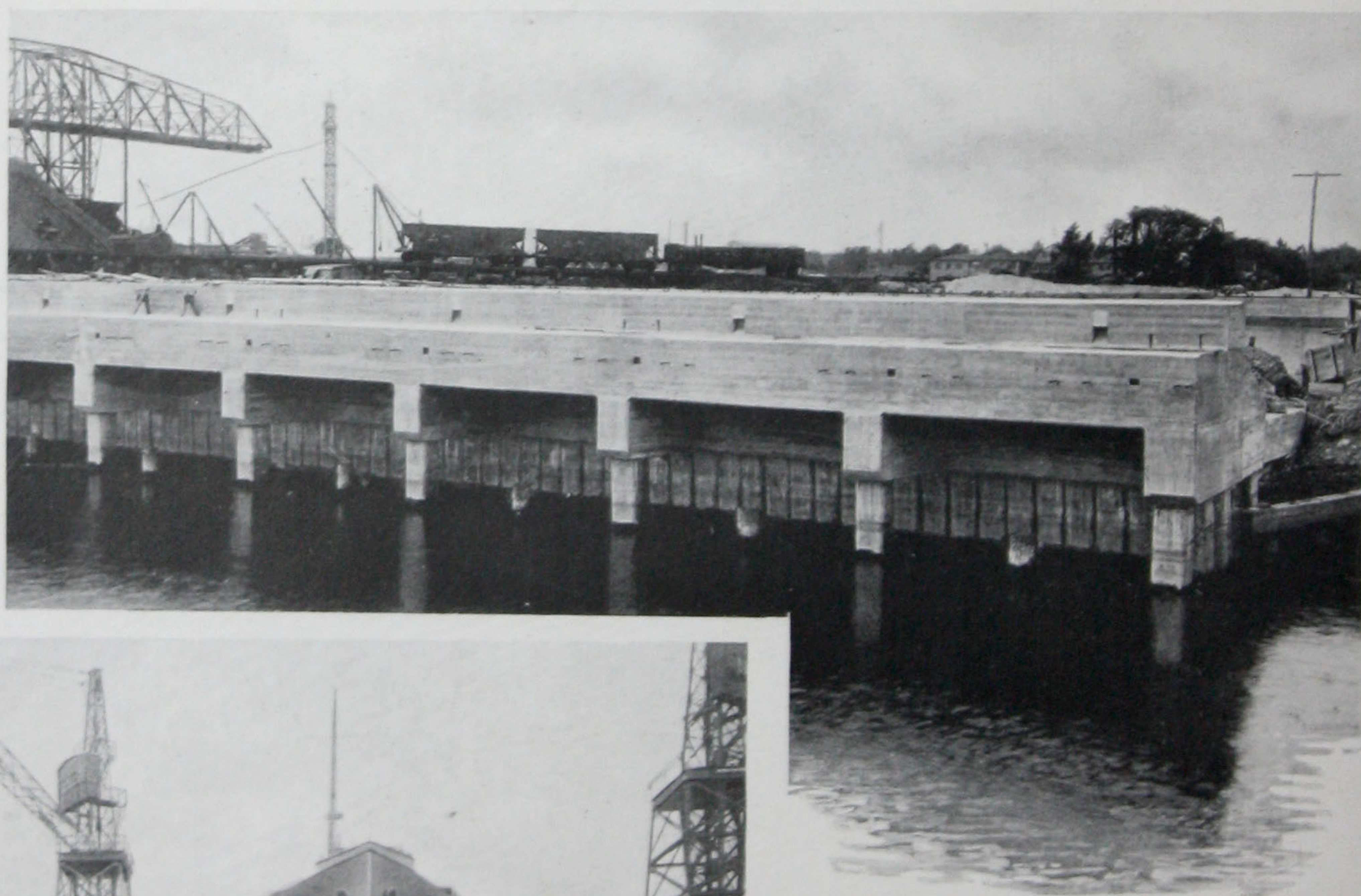


Interior of the dock shown on the top of the page

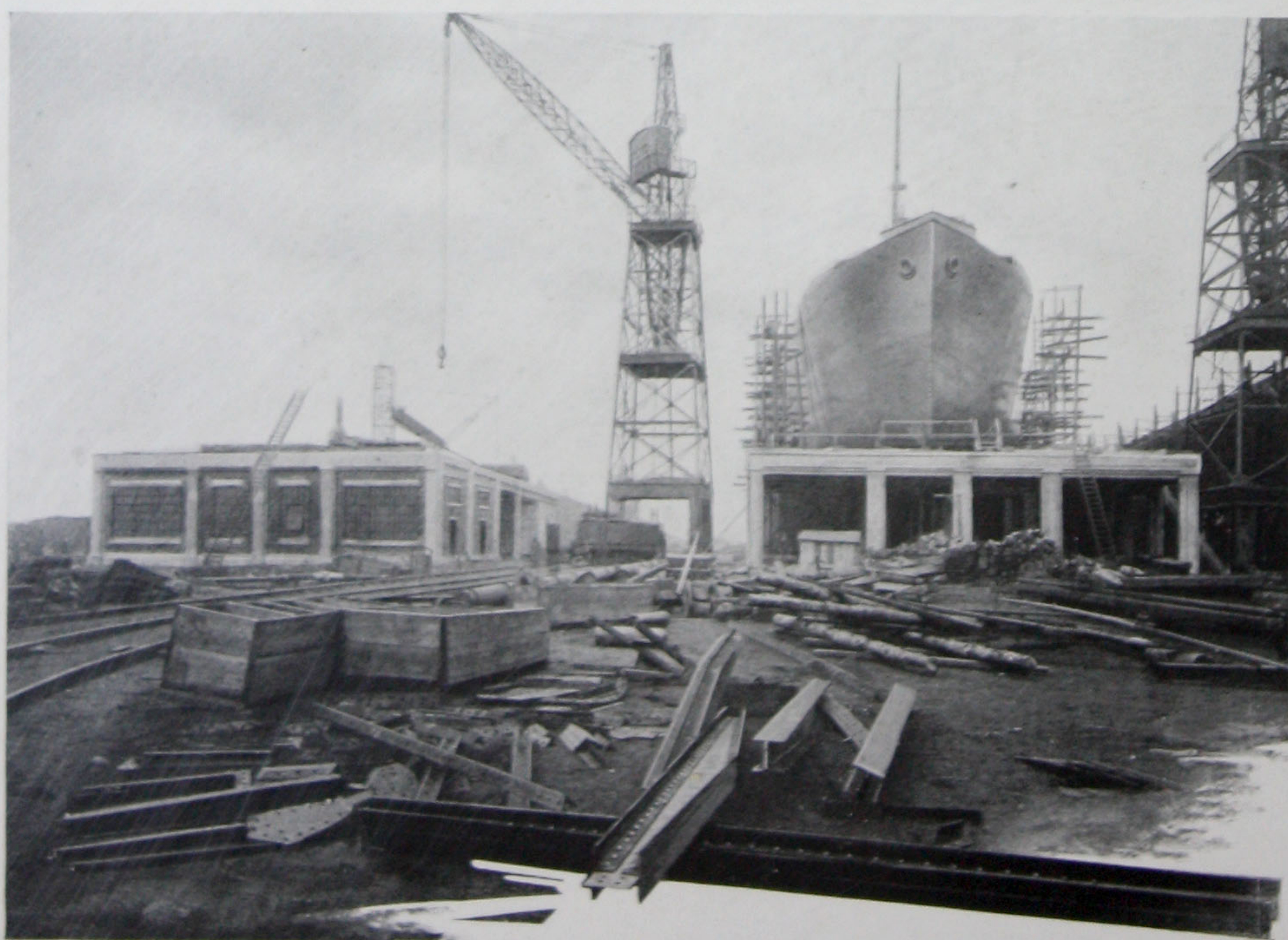
Reinforced Concrete Wharf
for the United States Naval
Academy at Annapolis, Md.



Reinforced Concrete Shipways for
the Bethlehem Shipbuilding Cor-
poration, Sparrows Point, Md.



Ore Unloading Dock of extremely
heavy construction for the Bethlehem
Steel Co., Sparrows Point, Md.

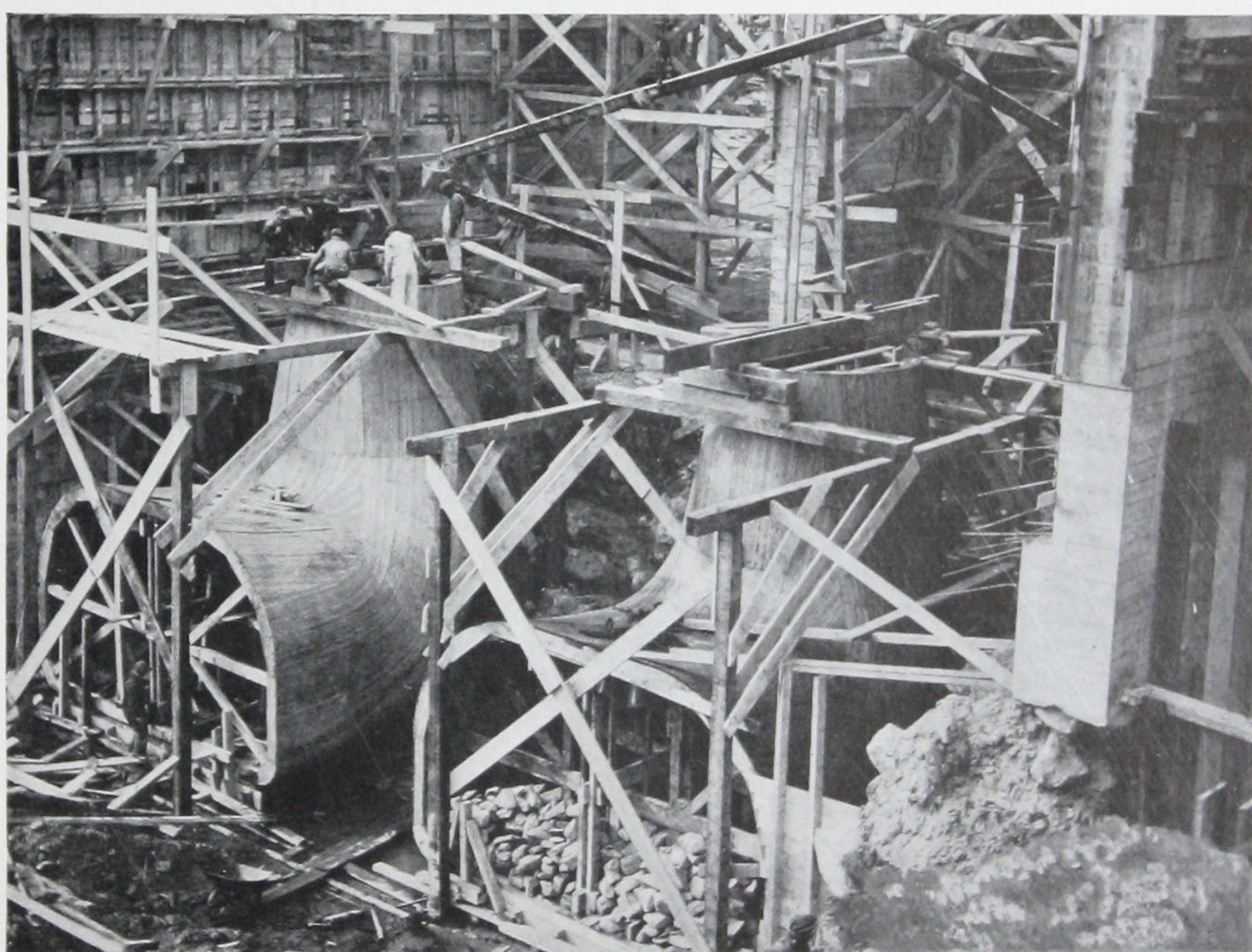


Latest type of Reinforced Concrete Ship-
ways with Quartermen's Stores therein.

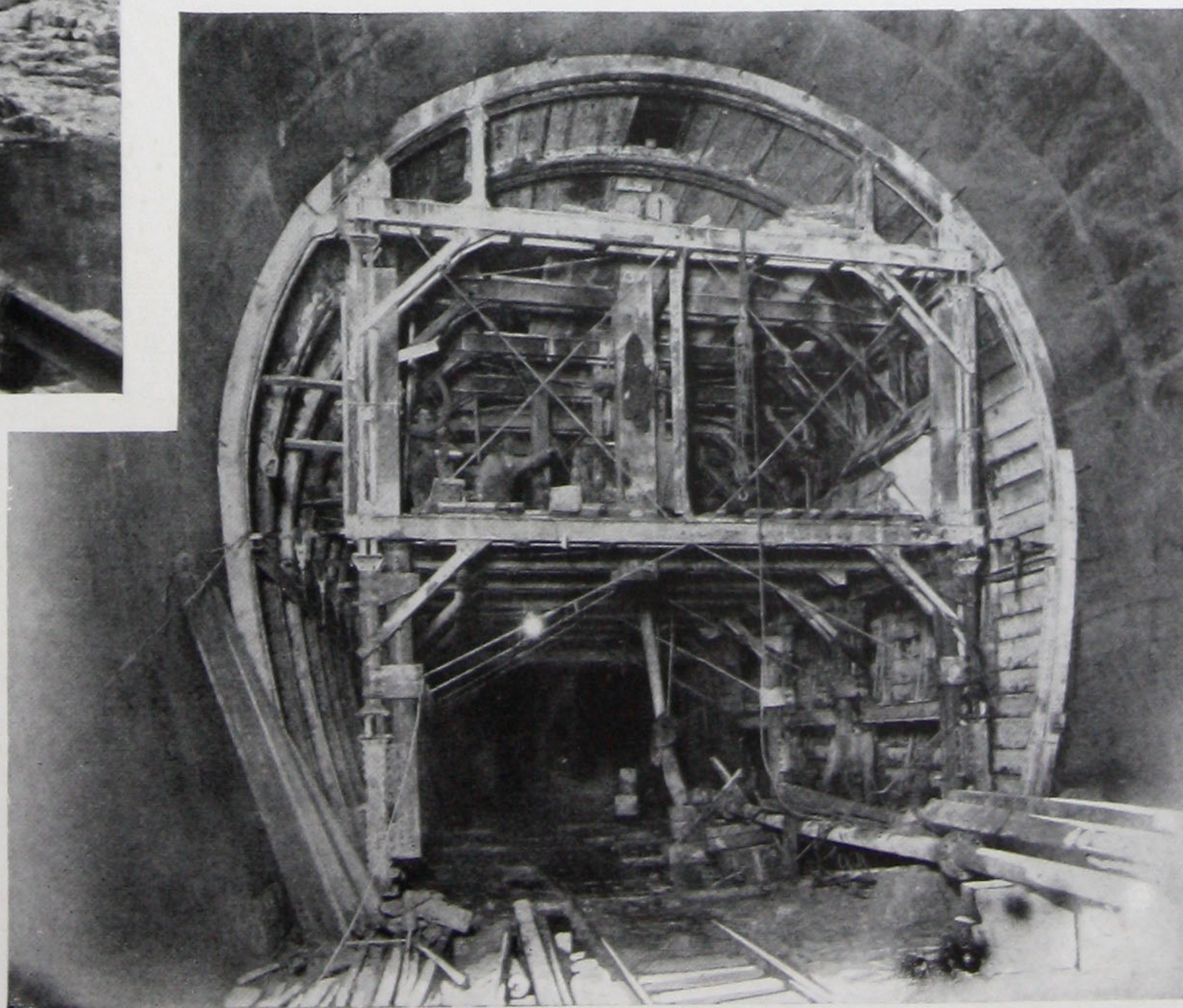


Hydro-electric development consisting of a dam and power house for the Nashua Manufacturing Company, Nashua, N. H.

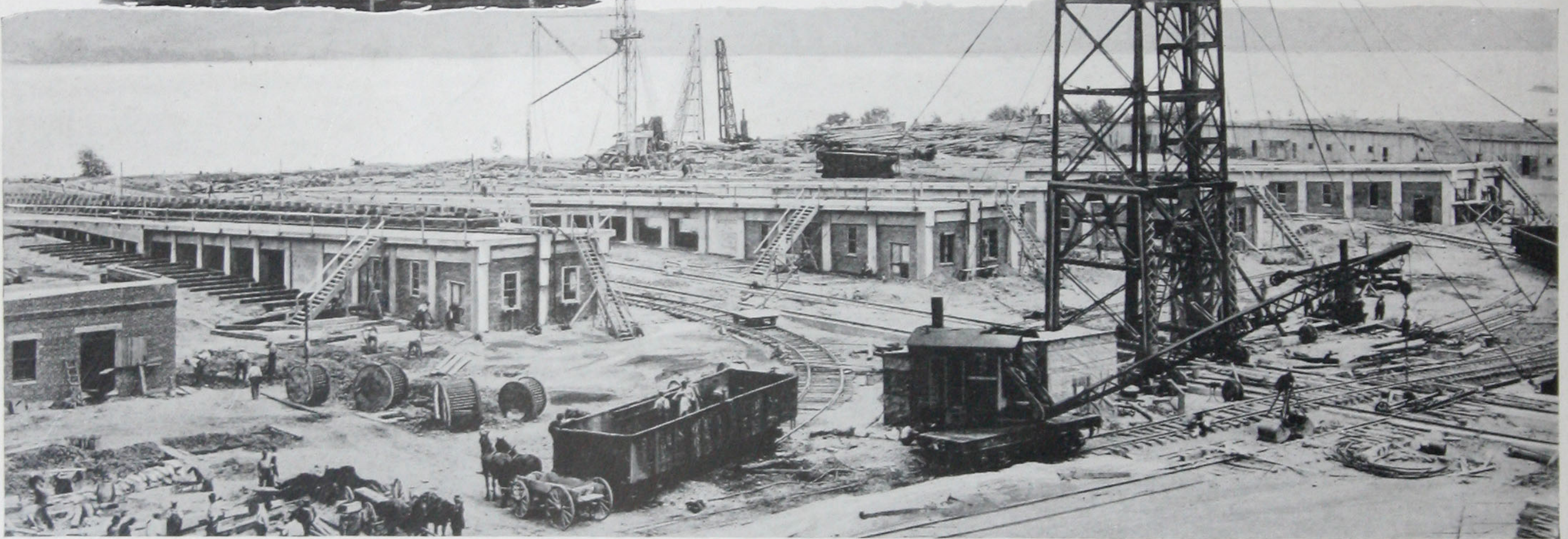
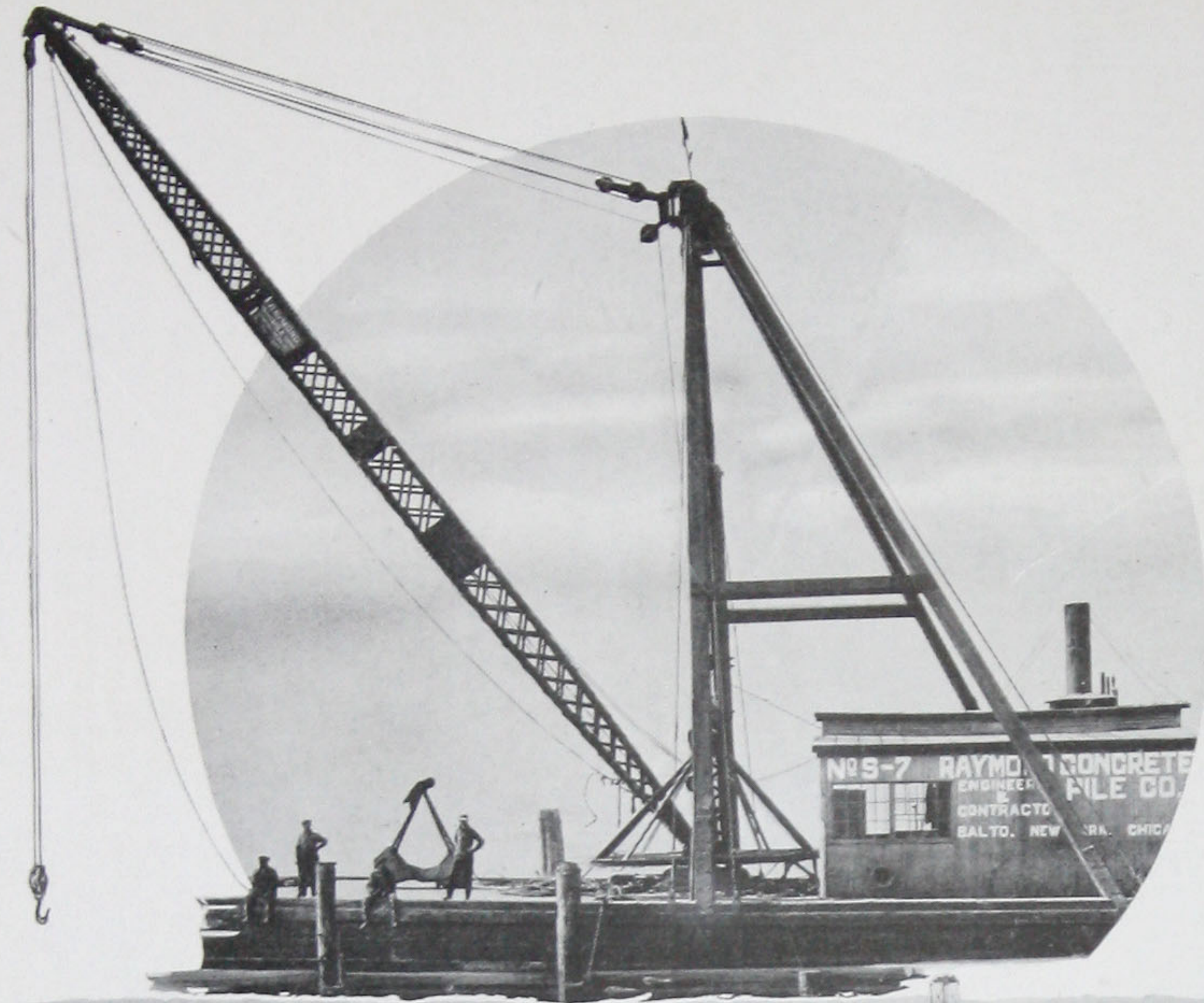
John A. Stevens, Engineer



Diversion Tunnel for the city of Kansas City, Mo.
32 foot diameter — 1600 feet long
Harrington, Howard and Ash, Engineers

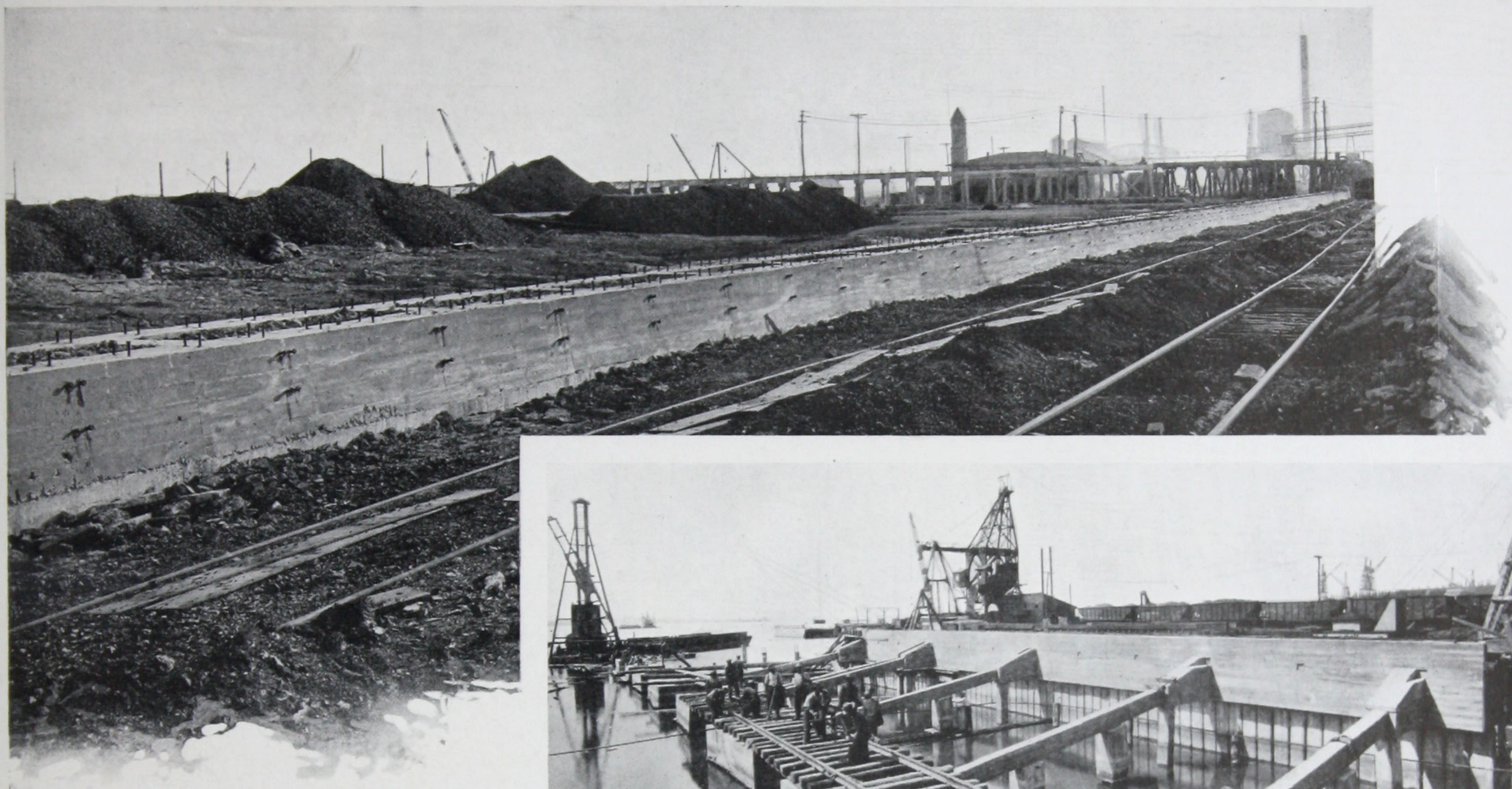


Four reinforced concrete shipways for the Virginia Shipbuilding Corporation at Alexandria, Va.



Quartermen's stores built into the reinforced concrete shipways

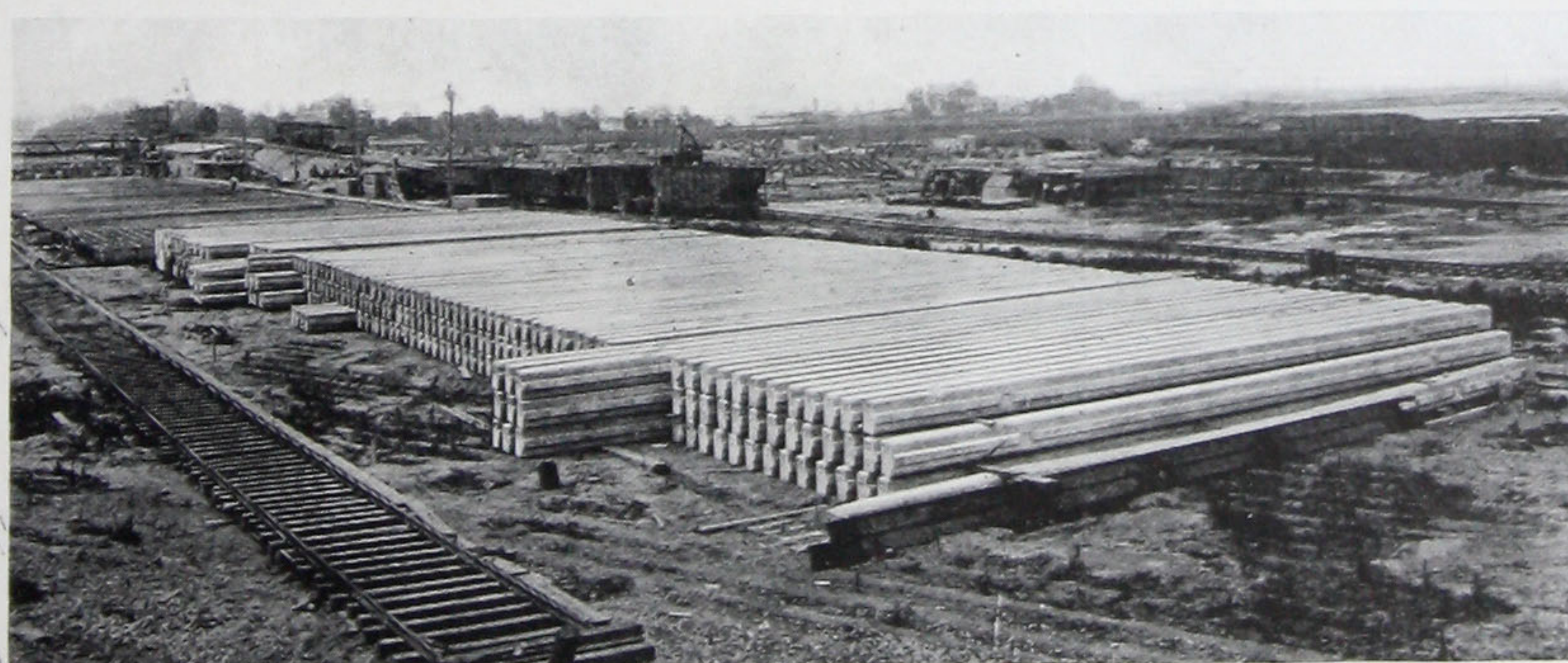




Track support for ore handling crane



Coal unloading dock
for the Bethlehem
Steel Company at
Sparrows Point, Md.



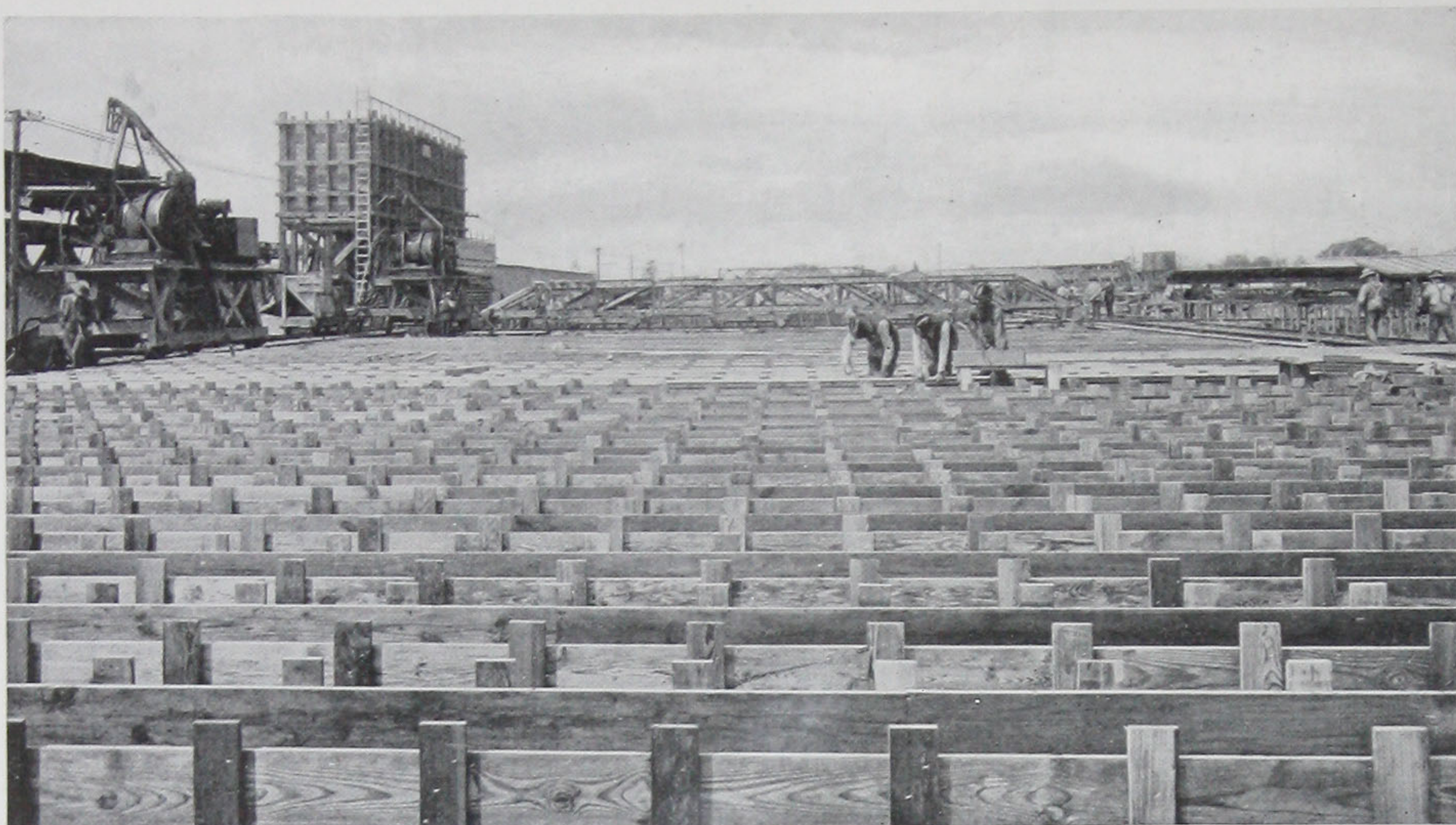
Pre-cast sheet piles ready
for installation



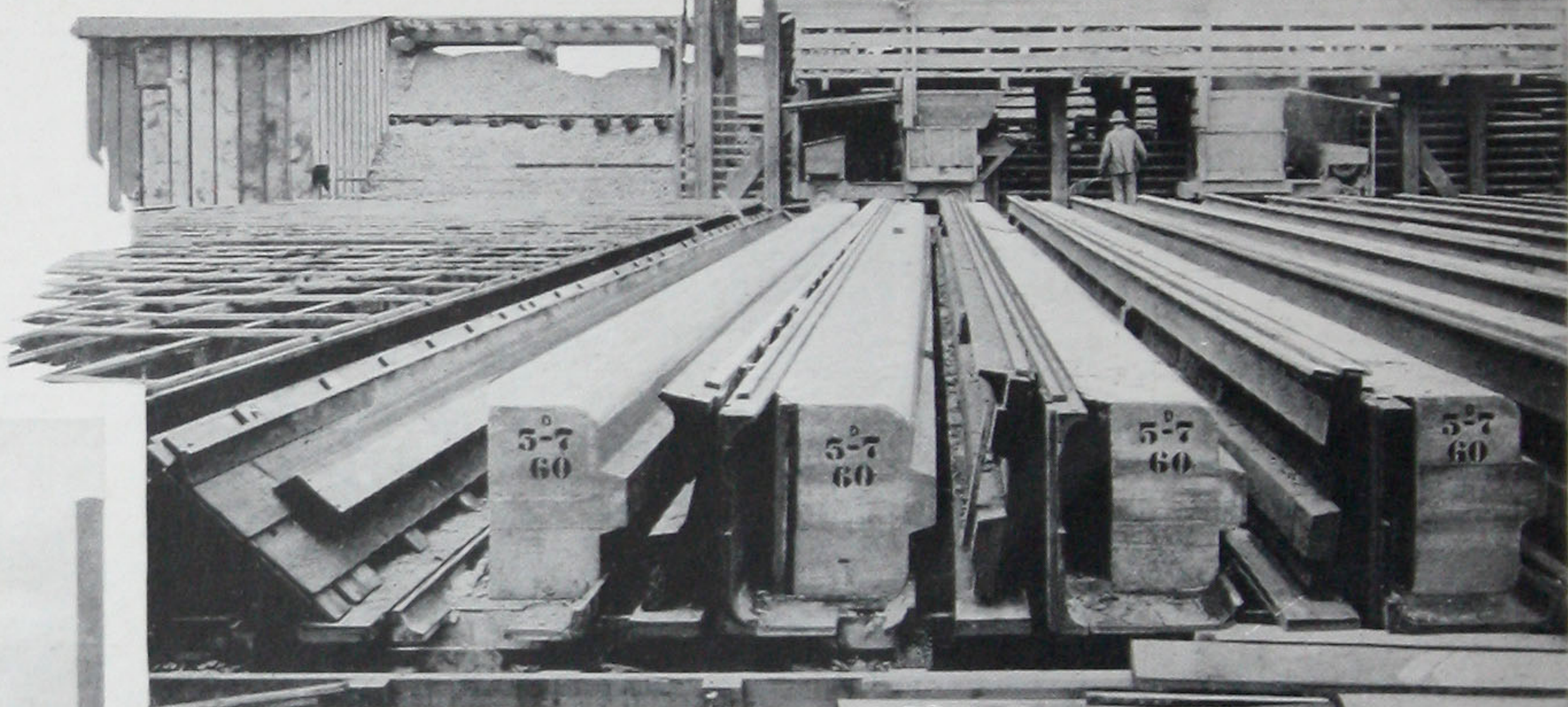
Timber construction for marine work



Pre-cast interlocking sheet piles in place ready for capping



Forms ready for casting
Reinforced concrete sheet piles

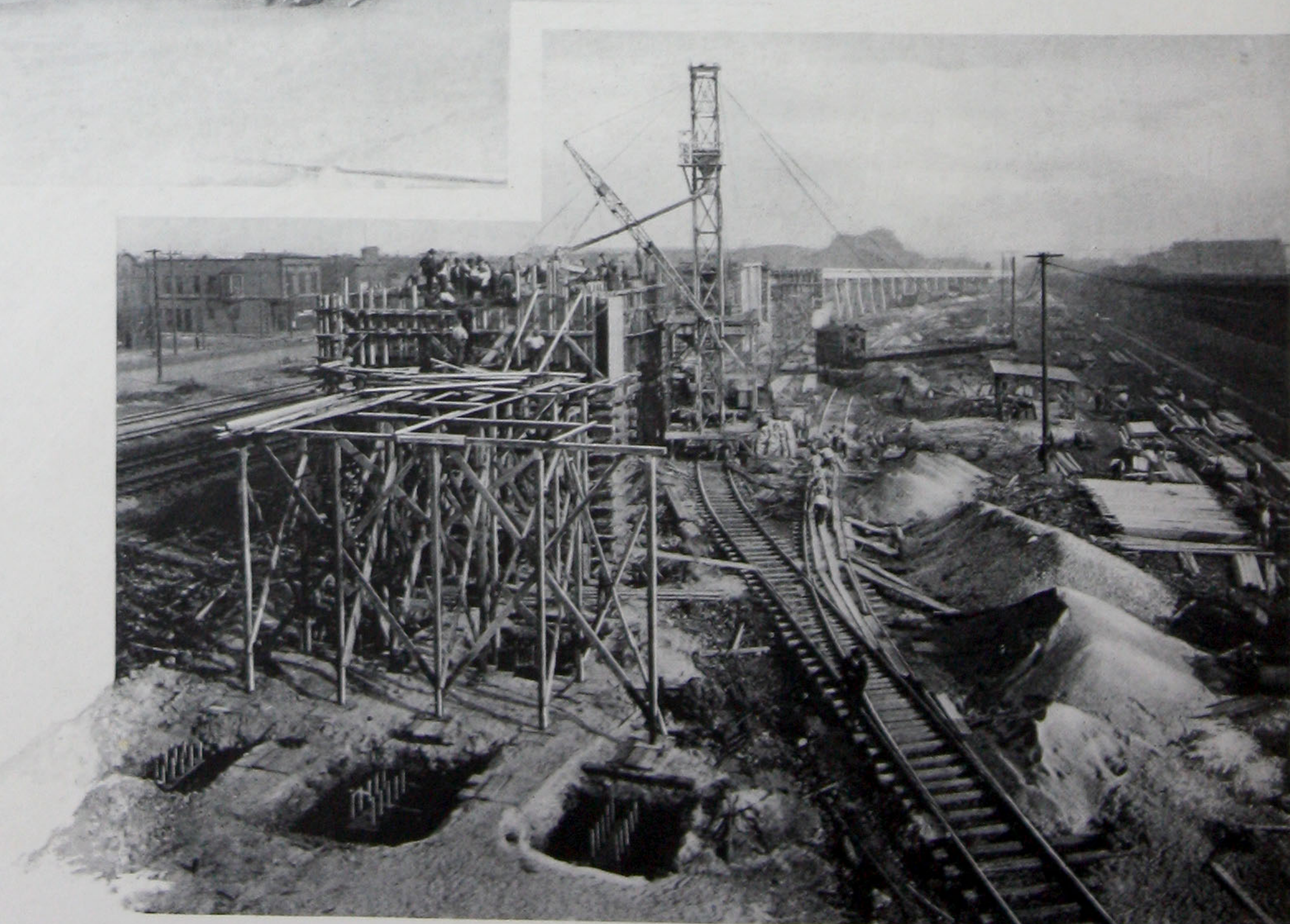


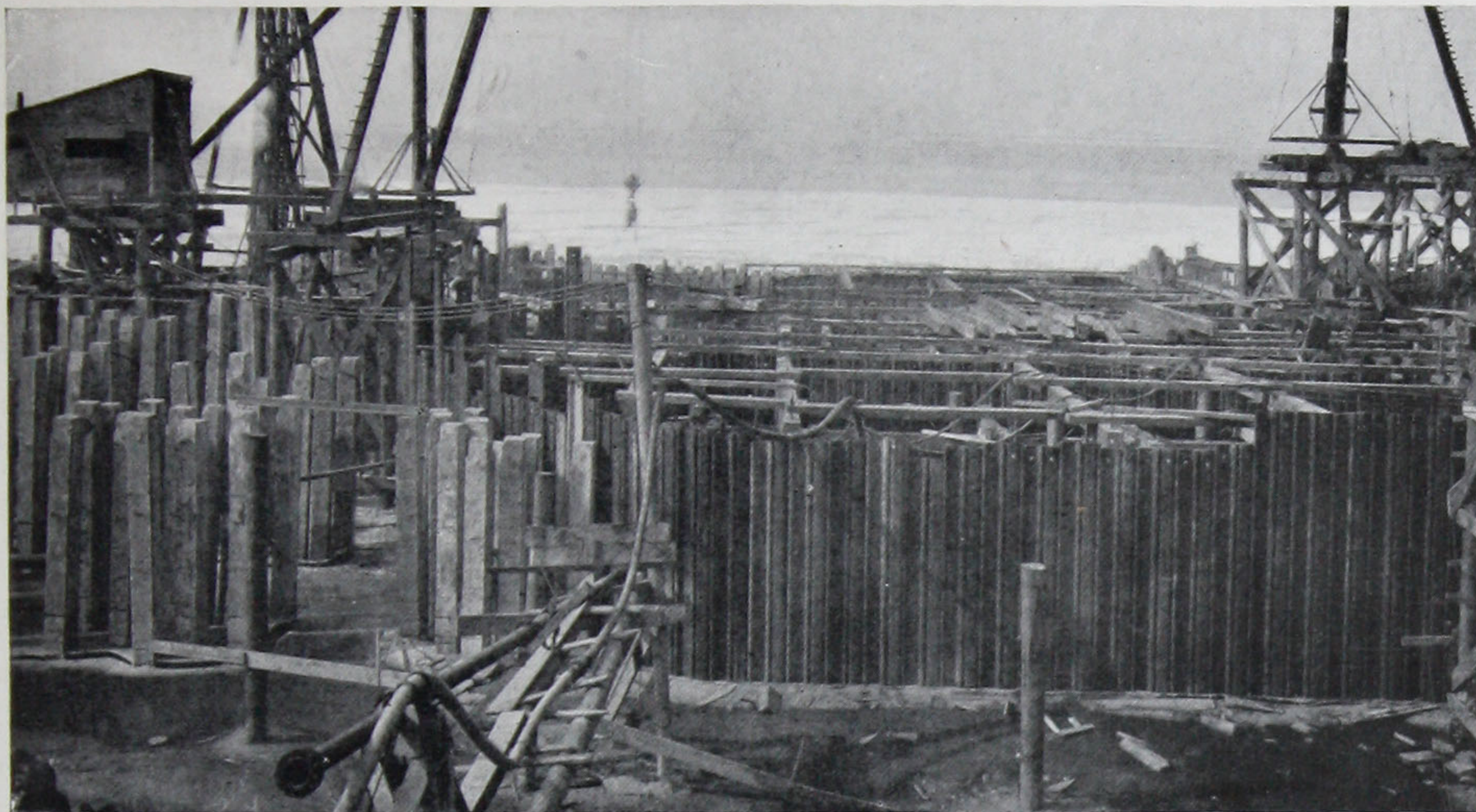
Removing forms from pre-cast concrete sheet piles
Note interlocking feature



Heavy ore retaining wall
of reinforced concrete

Reinforced Concrete
Trestle Construction

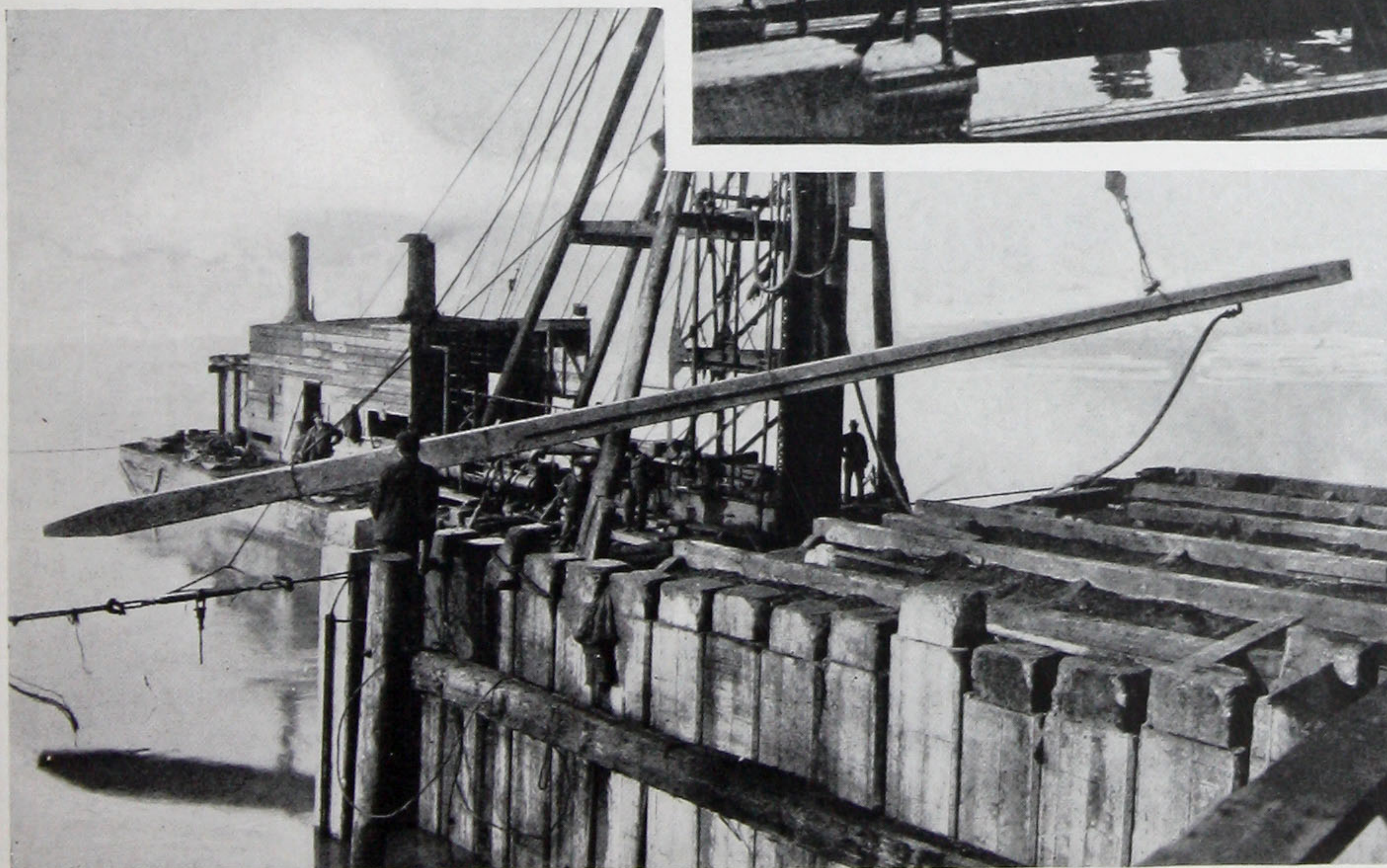




LEFT: A section, during construction of the steel sheet pile cofferdam for condenser wells at the Cahokia Plant of the Union Electric Light & Power Co., Cahokia, Ill., near East St. Louis.

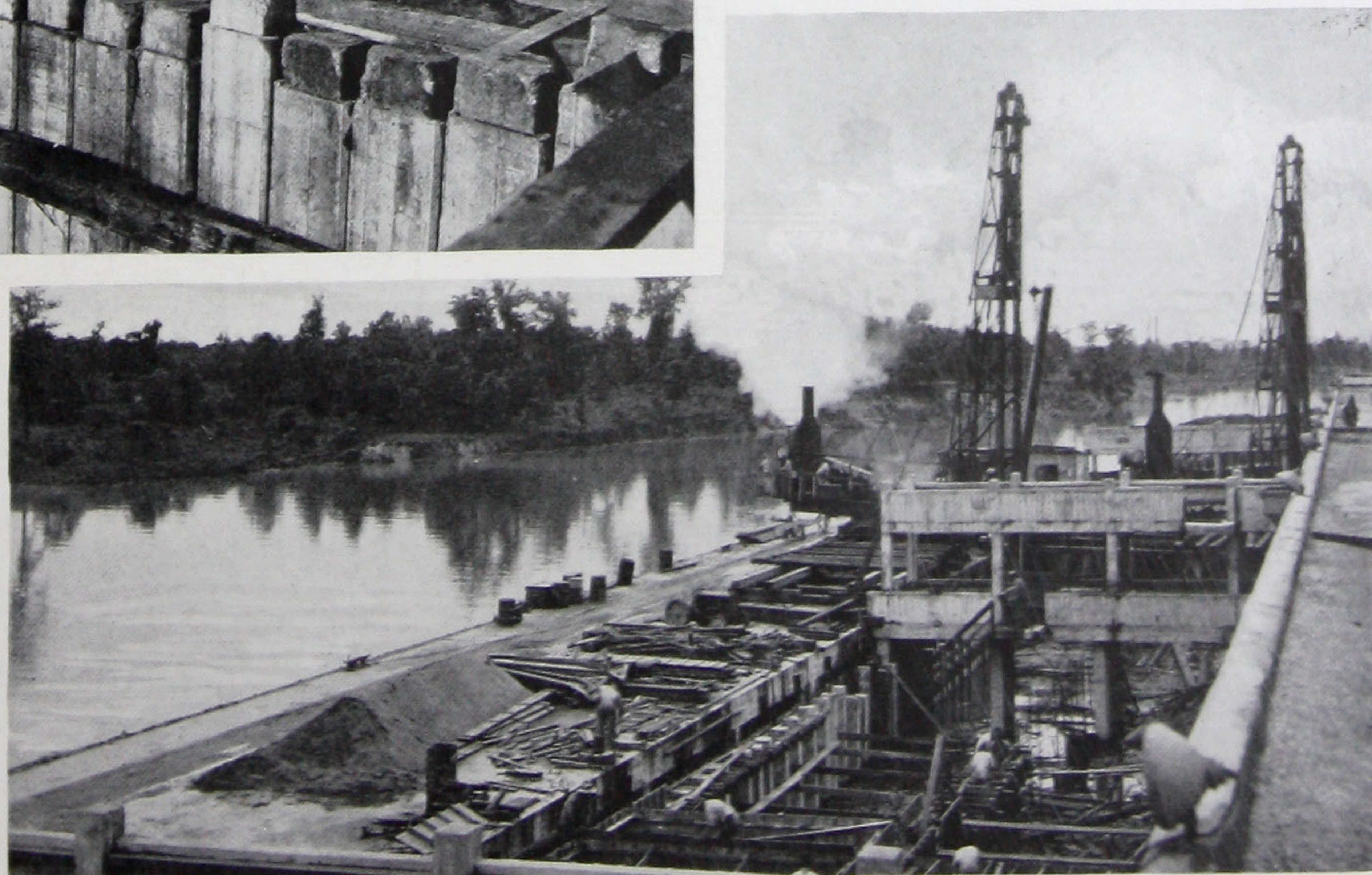
McClelland & Junkersfeld, Engineers.

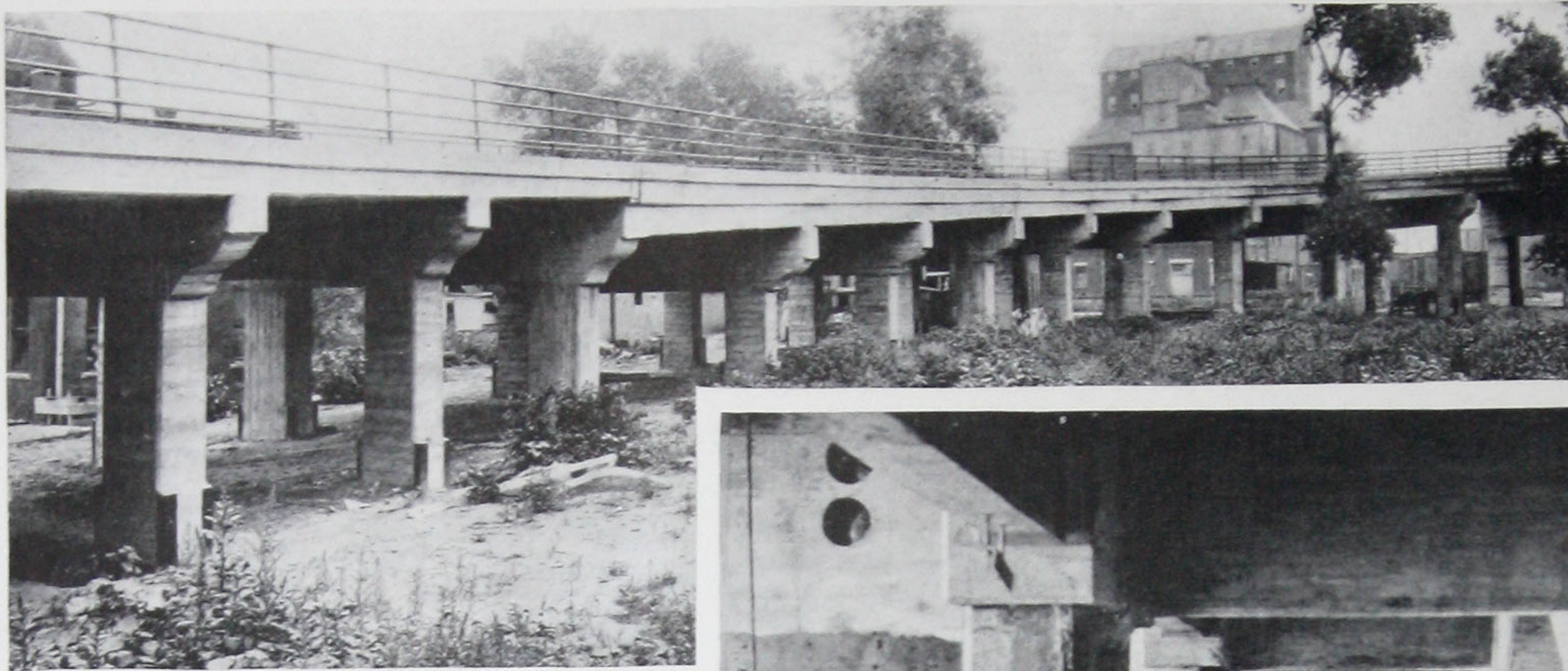
RIGHT: Precast Concrete Piles in foundation of Charleston, S. C., City Pier.



LEFT: A section of the Reinforced Concrete Interlocking Sheet Pile Bulkhead at the Cahokia Plant — sheet piles 75 feet in length.

RIGHT: Precast Piles and dock construction for Houston Compress Co., Houston, Texas.





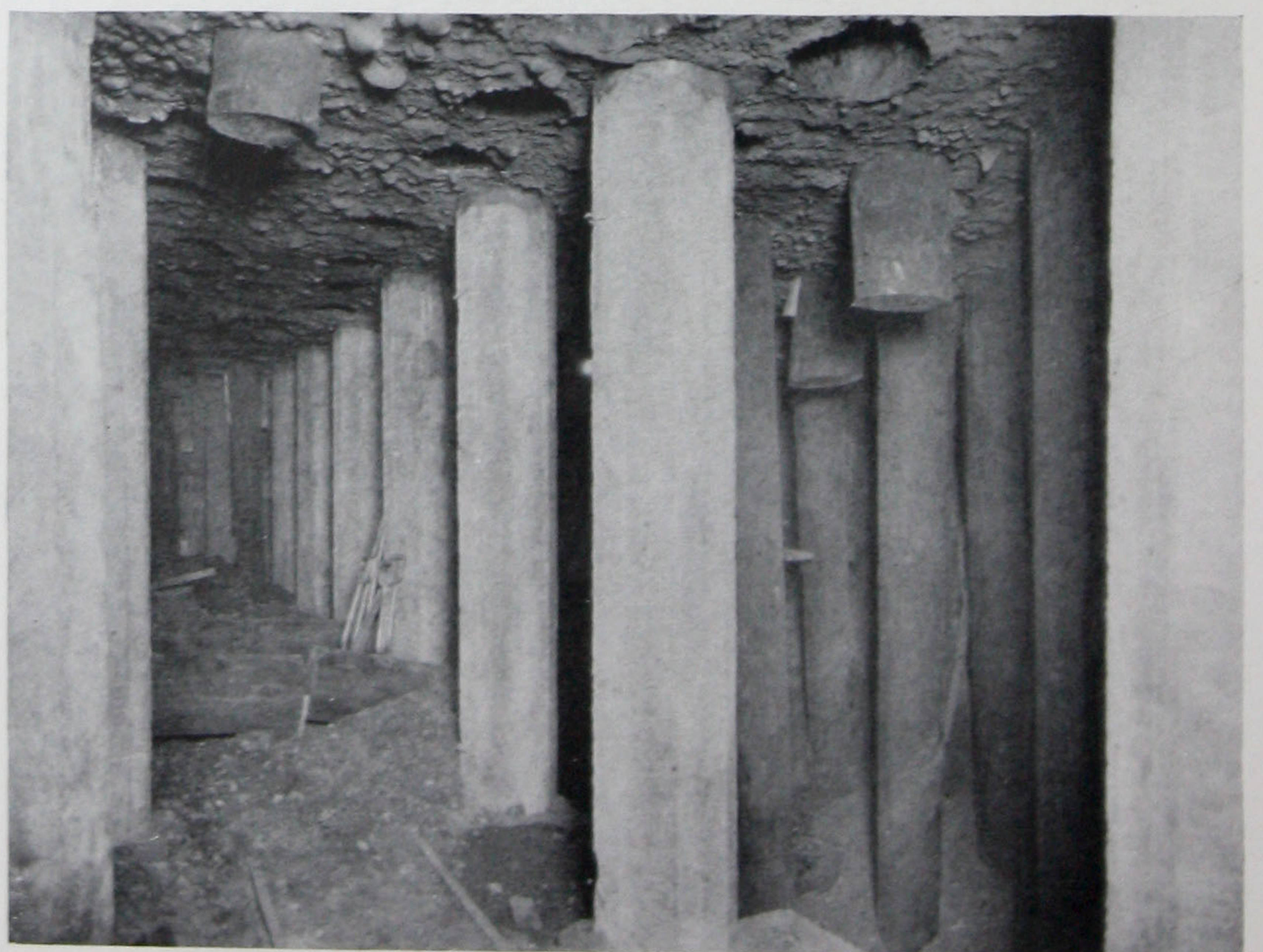
Chestnut Ave. Viaduct, Kansas City, Mo., founded on Raymond Concrete Piles.

View underneath Pier for U. S. Gov't. at Charleston, S. C.



Precast Piles and Concrete Highway, Trestle across Santee River, S. C.

Underpinning Slab and Turbine foundation for Portland Electric Power Co., Portland, Ore.





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